# Connected Corridor Trials (A2/M2)

TfL Lane Rental Industry Publication

TRANSPORT FOR LONDON

# Introduction

The increasing development of connected vehicles (CV) brings the potential for transformative change in the way people and goods are transported, offering significantly safer, greener and more efficient journeys, delivering economic benefits.

Cooperative Intelligent Transport System (C-ITS) CV services have the potential to significantly reduce incident and road works related delays, road accidents, emissions and help highway authorities manage their road networks more effectively. C-ITS CV technology can do this by providing road users with higher quality information about the road network in real-time, relevant to route and mode of travel, directly to the vehicle. This would enable road users to make more informed routes choices to avoid congestion and would provide greater awareness of potential hazards.

Transport for London (TfL) set out to develop, trial and evaluate the new 'proof of concept' C-ITS CV technology and services on the A102 between the Blackwall Tunnel and the Sun in the Sands Roundabout, and on the A2 between Greenwich and the Greater London boundary, to assess their potential road user and network benefits.

# Project Context

The project was TfL's contribution to the UK's A2/M2 Connected Corridor Project, a Department for Transport (DfT) led collaboration between TfL, the DfT, Highways England and Kent County Council to establish a C-ITS test bed corridor between Greenwich and Dover, on which four CV services could be piloted and evaluated by the four project partners.

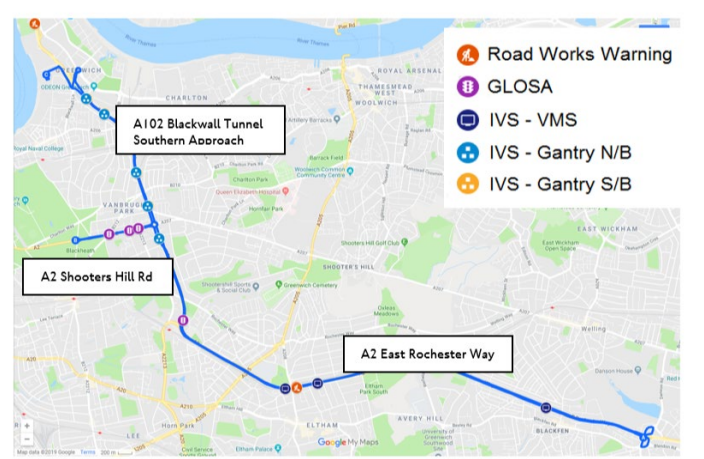
This UK project was part of a wider European project called InterCor, whose objective was to establish a CV test bed comprising of over 1,500km of inter-connected CV corridors in the UK, France, Belgium and the Netherlands, to test and evaluate CV services.

A key requirement and measure of success, was the developed CV services had to operate across highway authority boundaries and across international borders. This meant that there had to be no interruption to the service whenever a test vehicle transitioned from one country to another, or from one authority's road network to the next. In practical terms this meant that common technical and functional standards had to be established and used by all project partners for their pilots.

# Development Phase

The project had two phases, development phase and evaluation. The development phase commenced in July 2017 and was largely completed prior to the start of pilot operations in May 2019. However, some adjustments were made to TfL's CV systems following testing. During development, TfL successfully produced and deployed three CV services on its C-ITS test:

- **Roadworks Warning (RWW):** Accurate location-based hazard warning messages about road works. This service would lay foundations for future hazard warning services for both static and mobile works such as salt spreading messages or stopped vehicle warnings.
- **Vehicle Signage (IVS):** Reproduction of roadside Variable Message Sign (VMS) messages on in-vehicle displays. This new medium would have the potential to greatly improve road user experience.
- **Green Light Optimised Speed Advice (GLOSA):** Speed advice and countdown timer on approach to traffic lights. The potential here would be to reduce vehicle braking, improve the efficiency of vehicles approaching, leaving and waiting at traffic signals, thus improving journey times and reducing the emissions of equipped vehicles.



The location of TfL's CV services on the A2 and A102 C-ITS test bed

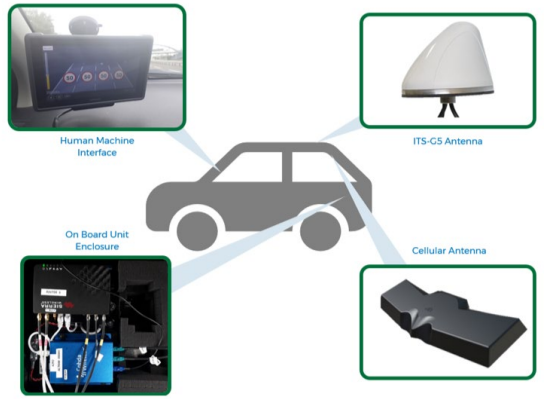
# CV Data

The partners developed a systems architecture that could combined traffic systems CV data with that from Highways England and Kent County Council, this would also enable the European partners to access TfL's CV data. TfL provided Urban Traffic System data and Highways England provided Motorway Traffic System data. This was in accordance with agreed technical and function specifications and standards, ensuring they were fully operable across borders.

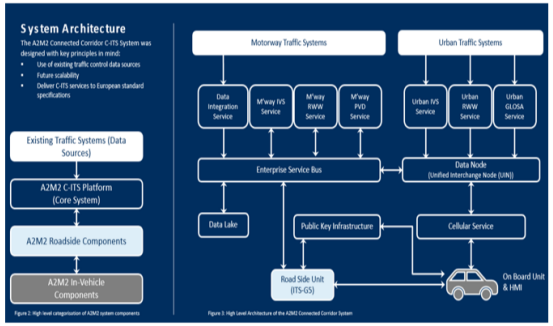
Data from the CVs were transmitted via 4G cellular communication or 5G short range wireless transmission from the roadside beacons. The test vehicles were fitted with specialist equipment that enabled the CV messages to be received, decoded and then presented to the drivers. In TfL project, CV services were delivered through cellular only, with roadside beacons not deployed.

The in-vehicle equipment comprised of the following components:

- **Human Machine Interface (HMI)** – dashboard display to present messages to the driver
- **On Board Unit (OBU) enclosure** – the 'brains' of the in-vehicle sub-system, which included GPS for location data. Typically installed in the boot with a wireless connection to the HMI and used to communicate with the core system via antennae
- **Antennae:** ITS-G5 and cellular antennae were used, affixed with strong magnets




A2/M2 Connected Corridor in-vehicle equipment




High level architecture of the A2/M2 Connected Corridor System

# Evaluation Phase

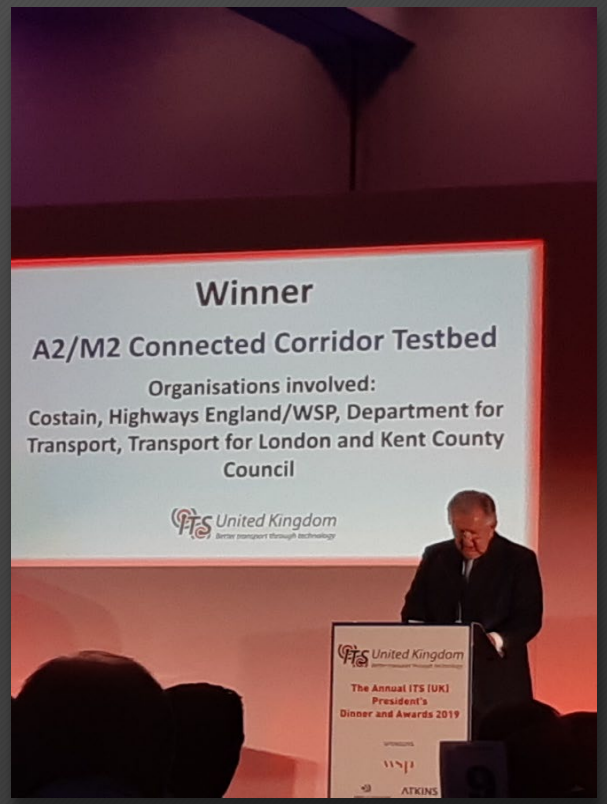
The evaluation commenced in May 2019, concluding in March 2020 and comprised of seven Focused Test Events (FTE), with each evaluating different aspects of the CV services.

CV messages were transmitted directly to a fleet of about 20 test vehicles via cellular 4G wireless communication and displayed via in-vehicle display screens (a HMI) to test drivers. The test drivers' responses to the CV messages and their user feedback enabled the potential benefits of the pilot to be assessed. The technical performance of the prototype that was developed to deliver the pilot CV services was also evaluated.

The project successfully achieved the objectives to develop and pilot new, innovative CV technology and services on the A2 and AI02, and to evaluated their potential benefits by delivering them as in-vehicle CV services to a fleet of test drivers. In recognition of its success, the UK's A2/M2CC project was awarded Intelligent Transport Systems (ITS) UK's prestigious Project of the Year 2019 award.  Delivered on budget, despite its duration being extended by six months by the European InterCor project team. It is estimated that if the C-ITS services were rolled out across London the, potential benefits could exceed £330m.

In general, the three pilot services performed either satisfactorily (GLOSA) or well (RWW and IVS). However, to provide the pilot GLOSA service, a technical work-around had to be devised by TfL Engineering, due to current Urban Traffic Control systems signal phase and timing data (SPAT) requirements. This affected the accuracy and reliability of the GLOSA service, compounded by intermittent 4G cellular service connectivity when test vehicles approached some of the GLOSA equipped traffic signals.

The presence of Bus Priority and Stage Ghosting at these signal installations may also have resulted in more variable traffic signal timings which meant that GLOSA's predictive algorithm was less able to predict signal timings between red and green. The GLOSA pilot was therefore informative, because it highlighted technical, operational and environmental factors that would need to be taken into consideration if rolled out in future. Detailed technical and user evaluations of the pilot services were undertaken and documented in Evaluation reports.

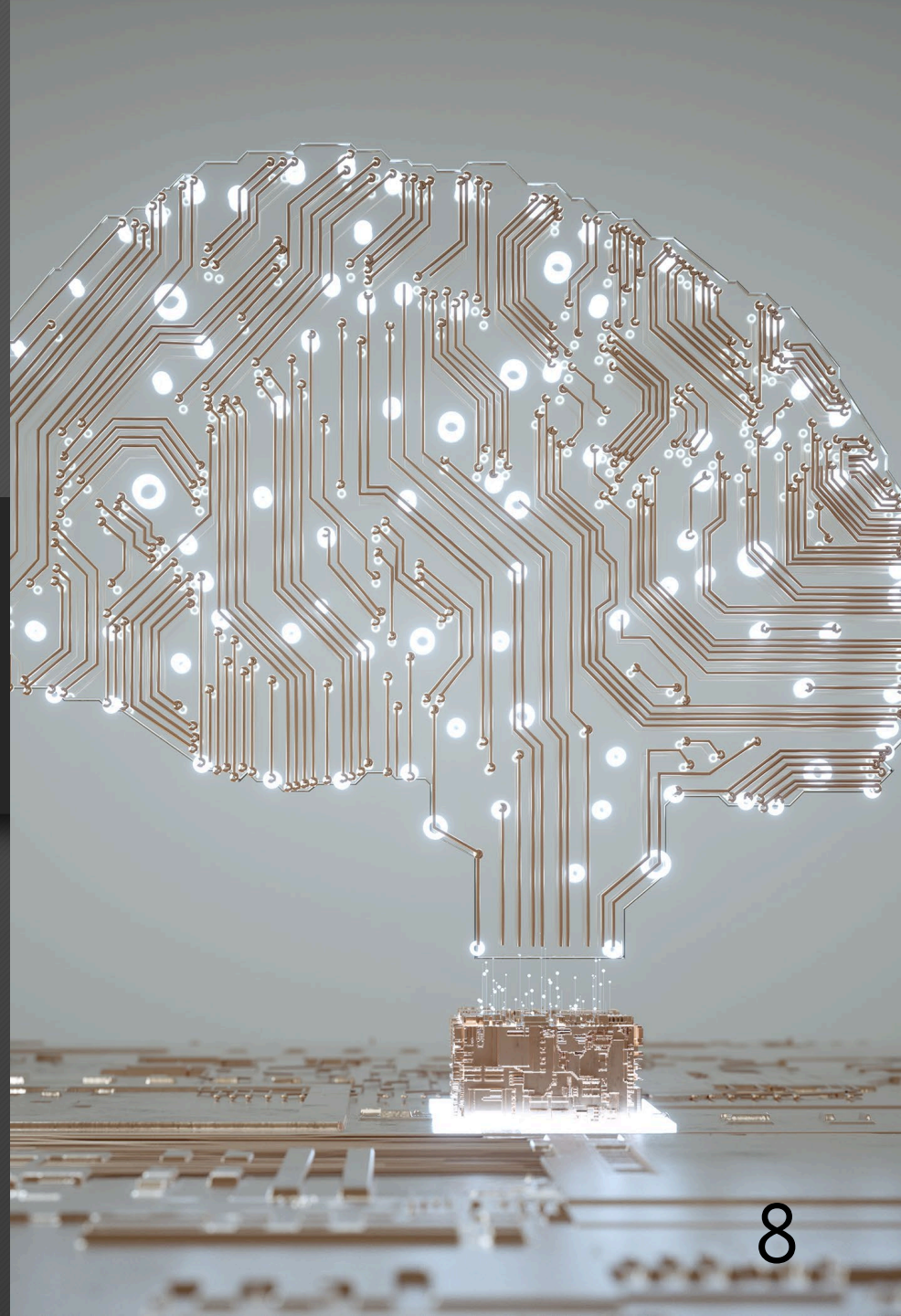



# Outcomes

# Lessons Learnt

It has been determined that the C-ITS technology is fit for purpose. Through the implementation of common CV specifications, services could be operable across regional and international borders.

Hybrid communications (ITS-G5 and cellular) is very effective, and the cellular 4G communications performs well with minimal latency where there is good network coverage. However, tunnels, cuttings and urban canyons can affect the performance of cellular CV services.



# Conclusion/Recommendations

The A2/M2 Connected Corridor project has successfully demonstrated real-time CV services on live urban and inter-urban roads. Using TfL's existing live traffic data sources, the project provided drivers with in-vehicle services that users provided positive feedback on, indicating they would use in the future. However, the pilot project also highlighted that if there is to be wide-scale roll-out of these types of CV services in future, investment would be needed to provide resilient, supported back-office environments and new secure data interfaces.

The project also highlighted the importance of understanding data requirements on a service-by-service basis, such as the need for sufficiently granular and accurate road works data to support the RWW service, and minimal latency on time-critical services such as GLOSA. These CV data requirements would need to be incorporated into traffic systems development roadmaps and future systems architectures.

The project also provided TfL and the other UK and European project partners with valuable insights into the potential road user and network benefits, if they were deployed on the network going forward. Technical and organisational challenges would also need to be addressed if these types of services were utilised across London in the future.

# TfL Lane Rental Scheme

Optimising customer journeys through the delivery of safer, innovative and sustainable roadworks

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