Multi-vehicle coordination

Connected digital services to improve driver decision making

Eloy

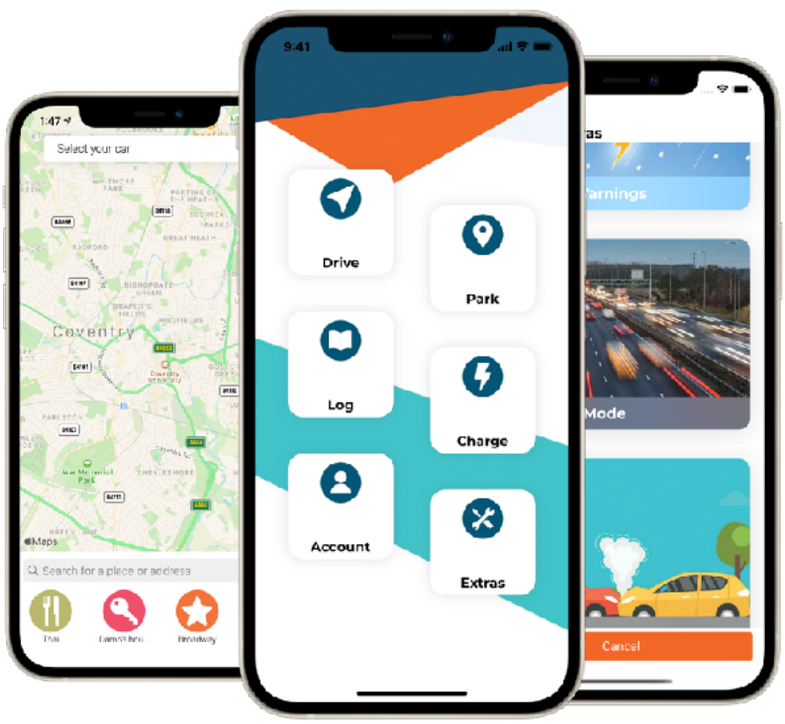
About us

Eloy is a connected and autonomous vehicle software business focused on multi-vehicle coordination. Our software includes patent pending methods for orchestrating how human-driven and autonomous vehicles travel.

Driver companion app
Our free mobile app is integrated with Apple CarPlay and Android Auto and includes its own in-built SatNav.

Software & IP
A suite of pending patents and proprietary software covering all aspects of connected and autonomous vehicles.

Research & development
Helping the CAV technology sector develop, build, and iterate ideas, and go from whiteboard to in-vehicle tests in just a few weeks.



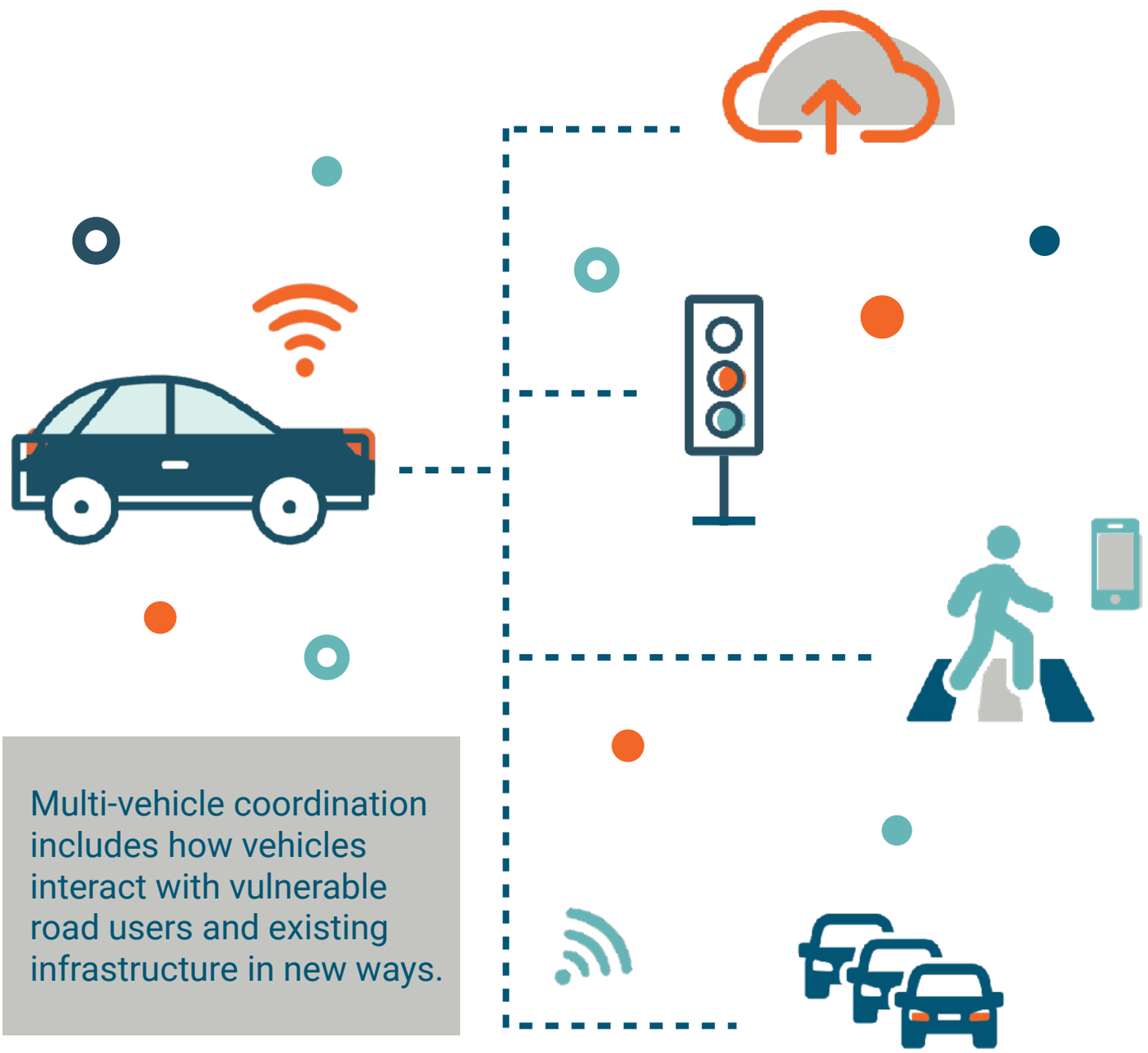
Eloy Extras

The Eloy Drive app has the ability to include 3rd party features within it.

This allows us to work on innovative projects, and rapidly deploy to a testing environment to help other organisations create new connected services.

V2X communication

One of the benefits of connected and autonomous vehicles is their ability to communicate with each other and other entities in sophisticated ways that will reduce road congestion, and make our roads safer.



Multi-vehicle coordination includes how vehicles interact with vulnerable road users and existing infrastructure in new ways.

Multi-vehicle coordination (MVC) is applicable to today's human driven vehicles as well as the long-term future's autonomous vehicles. It will also be essential for the transition period with human-in-the-loop drivers.

Introducing multi-vehicle coordination

All road vehicles are coordinated in some way.

This can be due to the physical layout of the road, such as roundabouts, the laws governing driving, such as speed limits, or by human behaviour, such as hand gestures and signals.

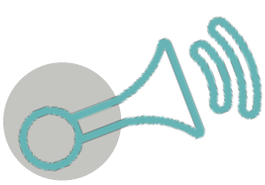
In areas where there is limited coordination, traffic chaos can ensue.

Road signs

Road markings

Traffic signals

Infrastructure



Audio alerts

Hand signals

Visual alerts

Looking forward, digital services can offer a new way of improving road coordination, particularly where physical infrastructure is inappropriate or it is prohibitively expensive.

In 2017, UK drivers spent an average of 155 hours stuck in traffic, costing the economy £37.7bn in direct and indirect costs, and the typical driver £1,168.

London was the most congested city, with an average of 13% of their driving time stuck in congestion, with 74 hours lost in peak periods.

Country lane passing places

On a single-track road, when two vehicles are travelling towards each other, the drivers must coordinate to avoid a head-on collision.

This usually involves one vehicle pulling into a passing place, to give the other vehicle room to pass safely.

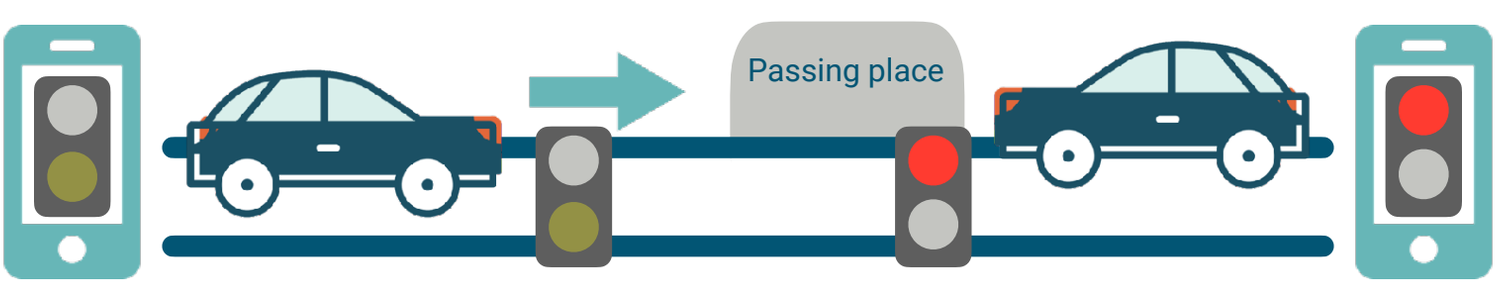
If the two vehicles meet very near each other, one vehicle may need to reverse to find a suitable passing place.

A lack of proper coordination, particularly on busier roads, can lead to time delays from vehicles reversing or traffic building up, and may have safety implications. This is more acute with agricultural and other large vehicles as well as with vulnerable road users

Virtual Traffic Signals

Instead of relying on drivers to cooperate and coordinate their vehicles we can use technology to broadcast ‘stop’, ‘wait’, and ‘proceed’ messages in-vehicle at appropriate points.

These messages, when combined with SatNav, act like virtual traffic signals, and can maximise the efficiency of vehicles passing on single-track roads, reducing stress for drivers, and removing the risk of a head-on collision.



Using AI to coordinate vehicles

On long stretches of single-track roads, several passing places may be needed, and manually adding virtual traffic signals to coordinate traffic could become very complex.

Two types of virtual traffic signals could solve this problem:

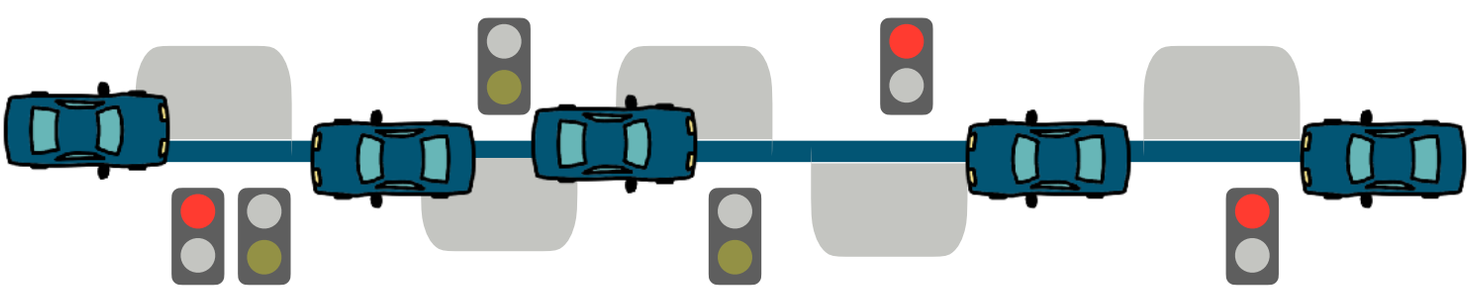
1. Fixed phase signals
2. Actuated signals

However, fixed phase signals are not efficient and may cause delays, while actuated signals would require sensors, although these could be provided by the vehicles themselves

Moving Beyond Traffic Signals

An alternative approach is to use Artificial Intelligence evolved from an actuated system, using mobile devices as the sensors.

The AI is trained to find optimised paths based on the current set of vehicles trying to navigate a single-track road with many potential passing places.

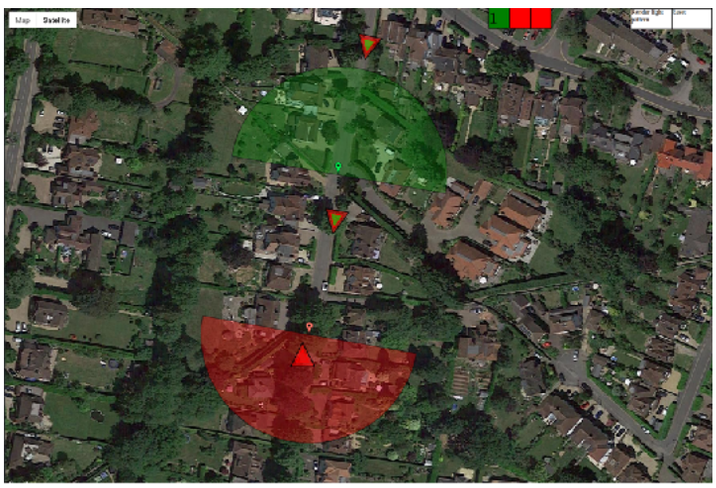


By using AI like this, we move from a virtual traffic signal system to a smarter way of coordinating vehicles that will maximise efficiency, and therefore improve journey times, safety, and emissions.

Training AI

Eclipse Simulation of Urban Mobility (Eclipse SUMO™) is a traffic simulation suite, that allows modelling of intermodal traffic systems.

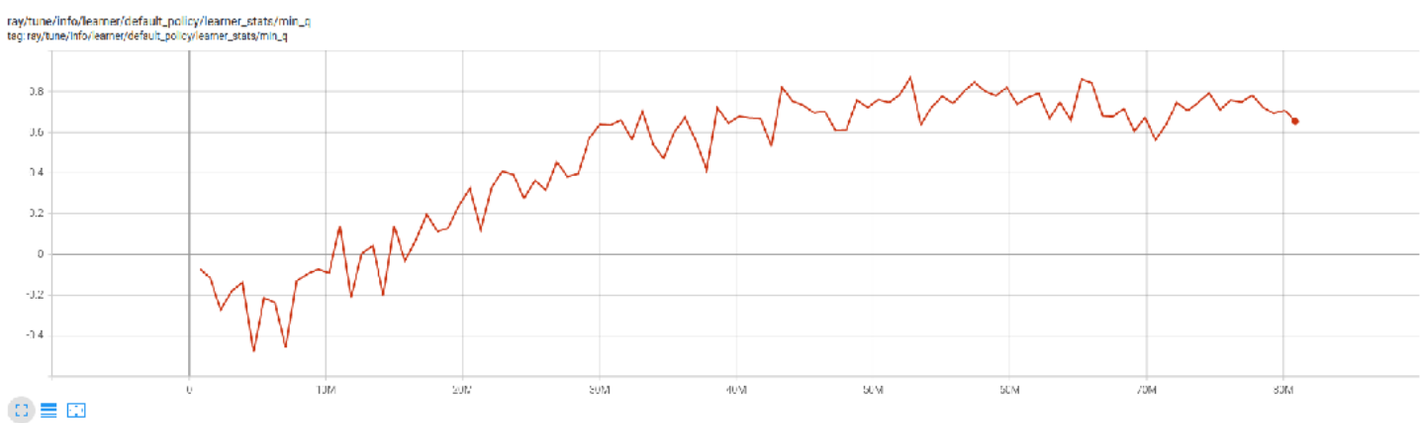
To train the AI, we created a reinforcement learning environment in SUMO. We defined several criteria, such as speed limits, no crashes, faster traffic flow, and set the AI to run many simulations with different traffic scenarios that met those criteria.



Over time, the AI creates a database of knowledge, getting better at learning what to do in each situation to achieve the optimal outcome based on the defined criteria.

From this, sets of binary signals are created that allow vehicles to move in one direction while stopping oncoming traffic, in effect creating a system of virtual traffic signals.

For drivers, these binary signals are broadcast as in-vehicle Stop or Proceed messages. Looking ahead to AVs, the car's software would automatically be able to interpret the binary signals.



The AI runs many simulations and aims to maximise its 'reward' (vertical axis) over time (horizontal axis). The reward is based on our input criteria that improves road safety and reduces congestion.

How it works

Transmitter

Vehicles are tracked within a reference zone when MVC is switched on. Tracking SDK in the Eloy Drive app. APIs to 3rd party data sources.

AI Processor

Artificial intelligence, based on reinforcement learning, uses live data and matches previously simulated and collected data.

Data Organisation

AI generates optimal path binary signals (1= proceed, 0 = wait) to achieve safe and efficient flow. Available as API or SDK for partner applications

Receiver & Display

Eloy Drive app manages MVC with in-vehicles messages generated from the binary signals. (Receiver, Human Machine Interface), Instructions displayed to driver.

The importance of SatNav

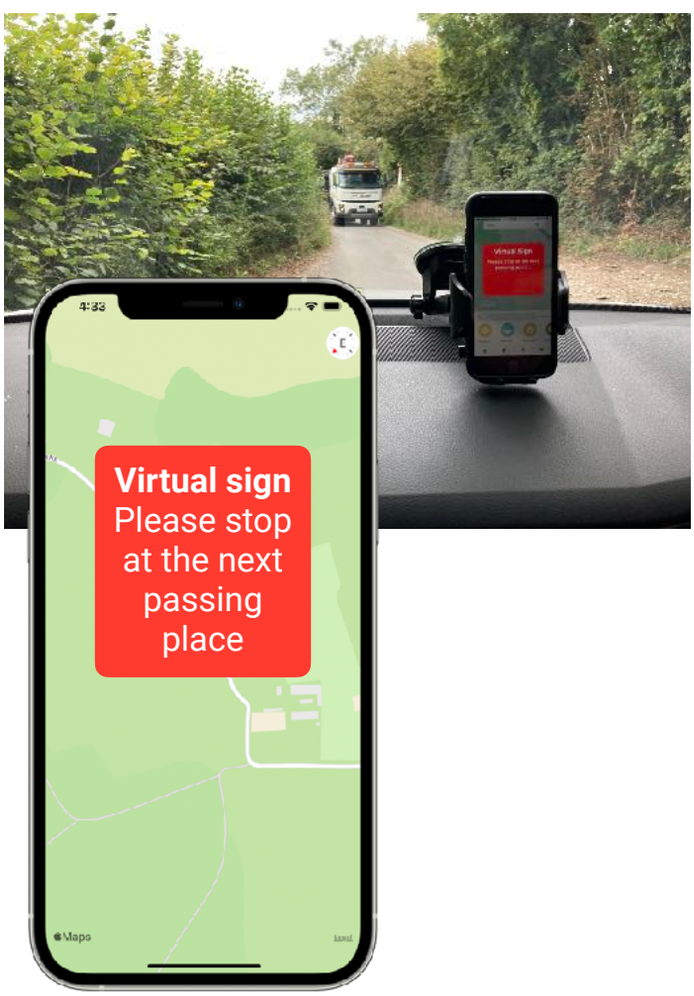
Currently, drivers use SatNav to get directions from A to B. With multi-vehicle coordination, SatNav will also need to give drivers information about when to stop or proceed.

From
Current SatNav

Individually optimised
No connectivity
No system control
Unintended consequences
Only specifies directions

To
Coordinating SatNav

Stop/go advice
Predict - avoid traffic jams
Identify - solve traffic jams
Personalised route instructions
Direction, lanes, speed, and timing, optimised and coordinated across multiple vehicles



Phased efficacy for multi-vehicle coordination

Phase 1

Prototype and features tests
2,3, and 4 vehicle tests
Videos, photos, evidence

Phase 2

Small scale trials
20 vehicles
Industry demonstration
Initial benefit assessments

Phase 3

Mid-sized trials
100s of vehicles
Greater cost and benefit evidence (efficacy)

Phase 4

Large trials
Local/regional controlled deployment
1000s of vehicles
Clear cost/benefit conclusions

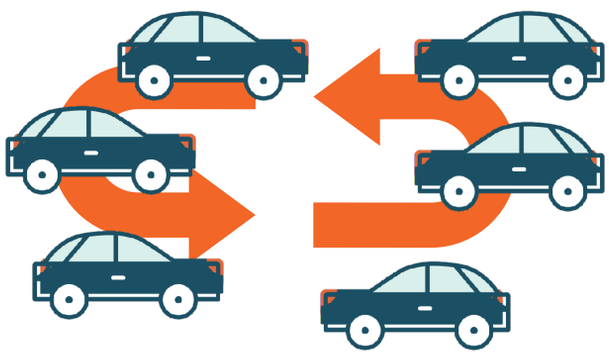
Deploy

Ongoing assessment
Evolution of service
Expansion of service (or other use cases

Road trials

Phase 2 includes the assessment of software on a small scale. This would be up to 20 vehicles on a private closed-loop road network.

1 mile loops with single track sections



20 vehicles, 10 travelling in each direction

Each vehicle interacts every 10 to 15 seconds

Measurement of efficacy in controlled environment

Evolution of connected vehicle technology

Infrastructure

Vodafone STEP
Yunex Stratos
SWARCO MyCity
Lumada
National Parking Platform
One.Network
Eloy Engine

Technology features

GLOSA
In-vehicle signage
Probe vehicle data
ETSI IVM/DENM/CAM
Blue light broadcast
Dynamic diversions
AI/ML coordination

Products & Services

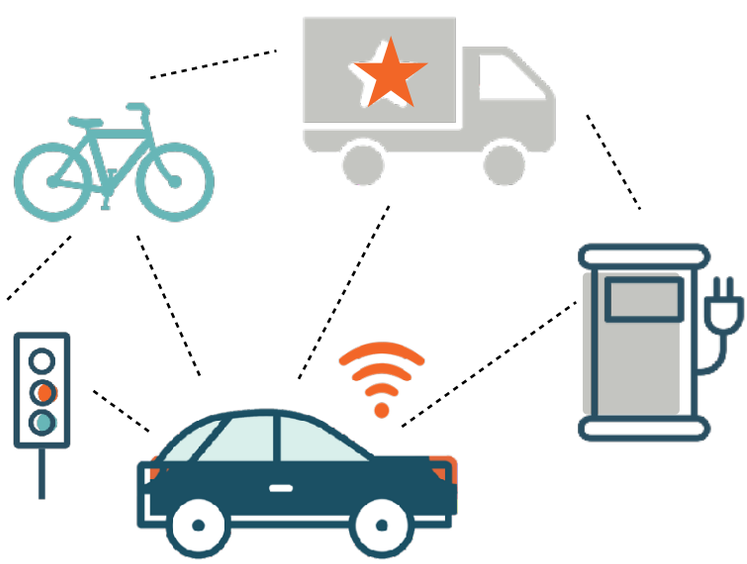
MVC country lanes
MVC ambulance alert
MVC cyclist overtake
MVC AV roundabouts
MVC ports & freight
MVC event parking
MVC EV charging

Product categories

Multi-vehicle coordination
Smart parking
Data brokering
SatNav
Roadwork management
Tolls & other payments

Pilots and demonstrations of functions and features to build products.

Clearly define connected vehicle technology services, and gather clear evidence of the cost benefit (efficacy).

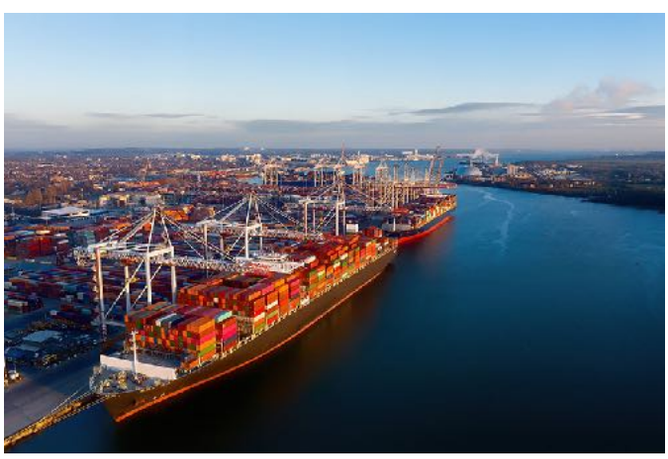


Further applications

Multi-vehicle coordination has many applications that can benefit people and the environment, as well as save money and generate revenue.

Schools

Parked and waiting vehicles alter the road layout and cause traffic congestion. MVC can control how vehicles manoeuvre in this environment.



Freight & logistics

The efficiency of ports and distribution centres could be improved with MVC by managing HGVs on the road network as well as on site.

Road hazards and blockages

MVC can be deployed rapidly to manage traffic congestion due to accidents, weather, and other environmental hazards.

Eloy

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