RAC Foundation

Mobility • Safety • Economy • Environment

LOOKING TO THE FUTURE BY CONNECTING TO THE PAST

About the Author

Andy Graham is a transport technology expert and the driving force behind White Willow Consulting, a company he set up in 2005 specialising in connecting vehicles and infrastructure. Andy has worked widely with highway authorities, the Department for Transport, roadside technology providers, vehicle makers and service providers on services such as driver information, smart parking, fleet management, connected traffic signals and eCall. He led the deployment of satellite navigation services in the UK.

Andy is a leading contributor to the Transport Technology Forum, and Chair of the ITS(UK) Connected Vehicles Forum. He also leads the working group on the deployment of Green Light Optimised Speed Advice in the UK.

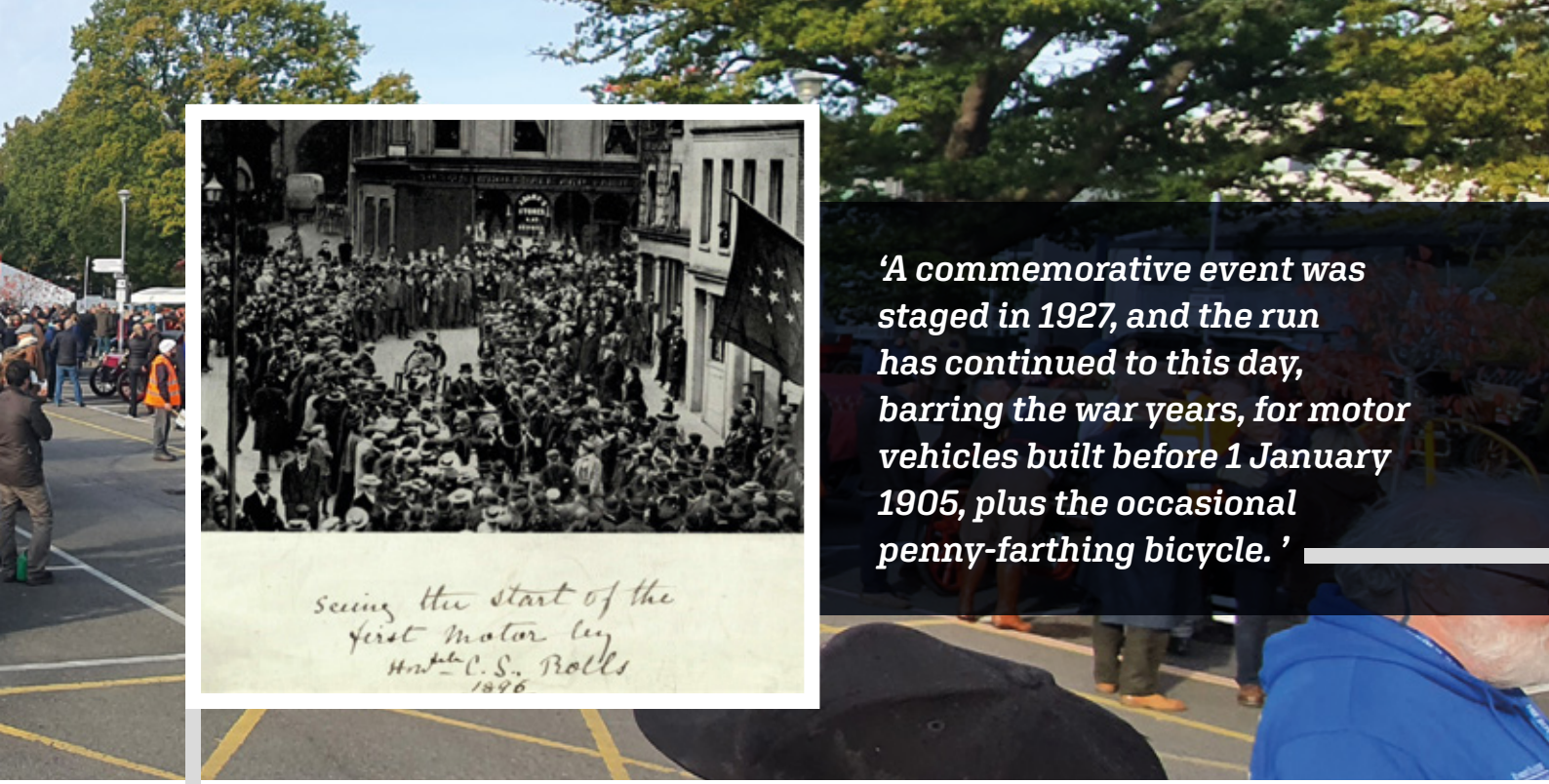
He is a Fellow of the Chartered Institution of Highways and Transportation, a Fellow of the Institution of Engineering and Technology and member of their Transport Policy Panel and a Trustee of the Rees Jeffreys Road Fund. He is a long-time spectator of the Veteran Car Run as well as many other motoring events, notably the 24 hours of Le Mans and the 12 hours of Wisborough Green, for which he has a half-built racing lawnmower.

Acknowledgements

The author would like to thank the RAC Foundation for commissioning this initiative and would also like to thank the drivers and crews who responded magnificently to the challenge of engaging with this pathfinder, to the staff of the RAC, in particular Michael Moment and the Motoring Team, the technology teams at KL Systems (George Brown), Eloy (Damian Horton, Anna Corp and Marcus Robbins) who developed the apps and hub from scratch, and were there supporting the project at all hours bringing a customer focus; Darren Capes and Paul Hutton of the Transport Technology Forum for capturing the imagery and user feedback in this report, and for massive practical assistance on the weekend; Paul Curtis helped bring a nutty idea to a practical and safe deployment that looked stylish and was practical come rain or shine; Iain Macbeth of Enterprise brought a hydrogen course car and much practical logistics help; Adam Graham at one.network for a custom-tailored roadworks feed, and Dominic Paulo for access to INRIX data on congestion; Jack Graham for coding and testing virtual signs and Sue Graham for logistics, lamination and moral support.

Disclaimer

This report has been prepared for the RAC Foundation by White Willow Consulting. Any errors or omissions are the author's sole responsibility. The report content reflects the views of the author and not necessarily those of the RAC Foundation.



'A commemorative event was staged in 1927, and the run has continued to this day, barring the war years, for motor vehicles built before 1 January 1905, plus the occasional penny-farthing bicycle. '

About the RM Sotheby's London to Brighton Veteran Car Run

The Locomotive Act 1865 introduced many interesting restrictions on motorised vehicles (to be fair, at that time these were mostly massive steam-driven traction engines) including the infamous requirement that any self-propelled road vehicle had to be preceded by a person walking ahead carrying a red flag, plus the world's first road speed limit: 4mph in the country, 2mph in towns, with "speeding" punished by a £10 fine.

After a great deal of lobbying by the founders of what was to become the Royal Automobile Club, in 1896 Parliament passed the Light Locomotives on Highways Act which created a new class of vehicle: the light locomotive. The Act raised speed limits to 14mph (though local councils still had the power to cap them at 12mph), and scrapped the red flag requirement. The door opened to the age of the motor car.

The Act came into force on the 13th of November 1896 and on the 14th this change in the law was celebrated by `Emancipation Day', when 35 cars and hundreds of cyclists, accompanied by some delivery vans, made their way from the Hotel Metropole, Northumberland Avenue, London, to the Hotel Metropole, Brighton.

Prologue

6.15am, Sunday 7 November 2021, before dawn, three veteran cars sit outside the Royal Automobile Club on London's Pall Mall ready to take part in the 125th anniversary Veteran Car Run down to Brighton.

Fully fettled by Club mechanic Michael, polished brasswork gleaming under the streetlights, there's something different about the cars this year. Because each has been fitted with temporary brackets to hold smartphones carrying an experimental 'app' designed specifically for the London to Brighton participants - with the phones in place, a 1900 Daimler, a 1901 Mors, and a 1903 Daimler have become the oldest connected cars in the world.

This report tells the story of how and why this happened, and, most importantly, what we learnt as a result.

The Royal Automobile Club Vehicles

1903 Daimler, driven by Duncan Wiltshire of the RAC Motoring Committee (Car 176).

1900 Daimler, driven by Graeme Hunt, well respected classic and veteran car expert (car 35).

1901 Mors, driven by RAC Chairman Ben Cussons (Car 62).

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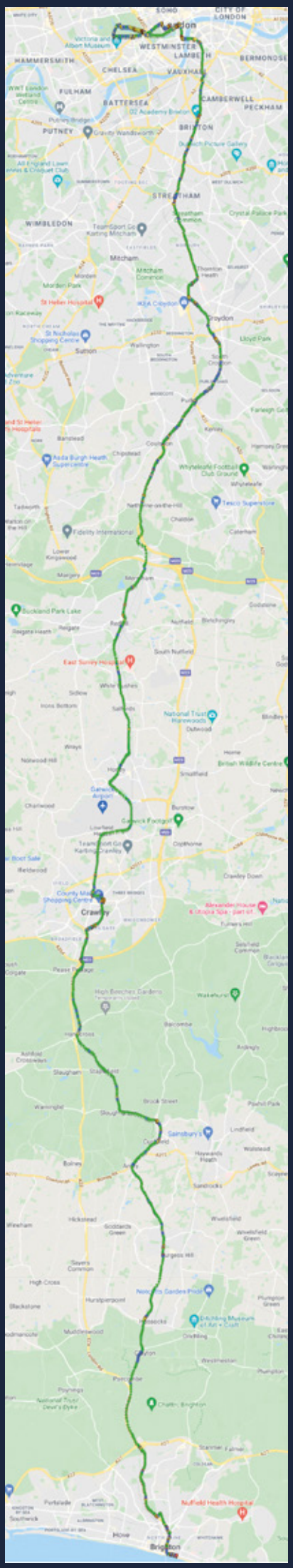


Image credits – thanks to Darren Capes, Steve Gooding, the 'connected London-to-Brighton team', and a special thanks to Paul Hutton for the video [**https://ttf.uk.net/community/spatula/watch-5-minute-video-report-on-the-london-to-brighton-connected-veteran-cars/**]

Introduction

'Connected' and 'autonomous' – when it comes to vehicles these two terms tend to be said together, as closely linked as "Gilbert and Sullivan", or "Ant and Dec", but while autonomy is still a promise not a reality, connectivity is with us here and now, and not just for the latest cars with the latest whizzbang tech built into them. As the RAC Foundation report 'Driven by Information' *(https://www.racfoundation.org/research/mobility/driven-by-information)* **showed last year, connectivity, by itself, can offer many benefits in reducing congestion and emissions, and improving safety.**

So, this report is about how we took three participants in the 2021 Veteran Car Run and made them the world's oldest connected vehicles, aiming to:

- show that 121-year-old vehicles can connect with other vehicles and roads infrastructure, allowing them still to use roads in the automated years to come;
- solve practical challenges of integrating new tech in old vehicles;
- learn lessons for all connected vehicles about linking to roads, and how to use data from vehicles.

The Foundation wanted the project to demonstrate something beyond the wonders of satnav, which many road users already experience. The value of connectivity comes not just from the information that can be sent to the vehicle but also from what the vehicle itself shares. The Veteran Car Run provided a perfect test-bed for demonstrating the potential of the technology for real, to get early feedback and improve services, hopefully for future deployment. We had the ideal mix of drivers hungry for information about the road ahead and marshals keen to know what the participants were facing, and what they were up to. Such testing in real-time today would be called "agile" development, but in the spirit of 1904, we prefer the term "pathfinder".

This was a team effort from a group of small British innovators, supported by the RAC Foundation and Transport Technology Forum and with many others offering invaluable help, data, advice, tea and enthusiasm.

We now start our journey not at Hyde Park, but in the best tradition of British innovation, in a variety of sheds, home offices and a converted barn in Surrey.

'Making clipboards.'

Before the run – in the workshop...

We wanted to test how well several aspects of a connected vehicle could work to:

- provide data on its location and status to the organisers, course officials and mechanical support teams (tracking);
- send location specific messages to all vehicles (in-vehicle messaging) – such as fixed or variable signing;
- send individual messages to specific vehicles and allow them to report back (e.g., if broken down);
- for those not familiar with the route provide a bespoke sat nav (A conventional sat nav would have taken participants onto the motorway and other fast roads; we used the official fixed route).

All of the above exists already, and creates a foundation for adding other services, such as smart parking, green light optimum speed advice (GLOSA) and a variety of other new ideas. But for the 2021 run, our priority was to develop something that would be of use to the participants and the organisers of the Veteran Car Run, that would draw from many existing services. However, it would recognise their specific needs and be tailored to their requirements in a way that layered services one upon another rather than requiring the users to open multiple apps.

Consequently we developed:

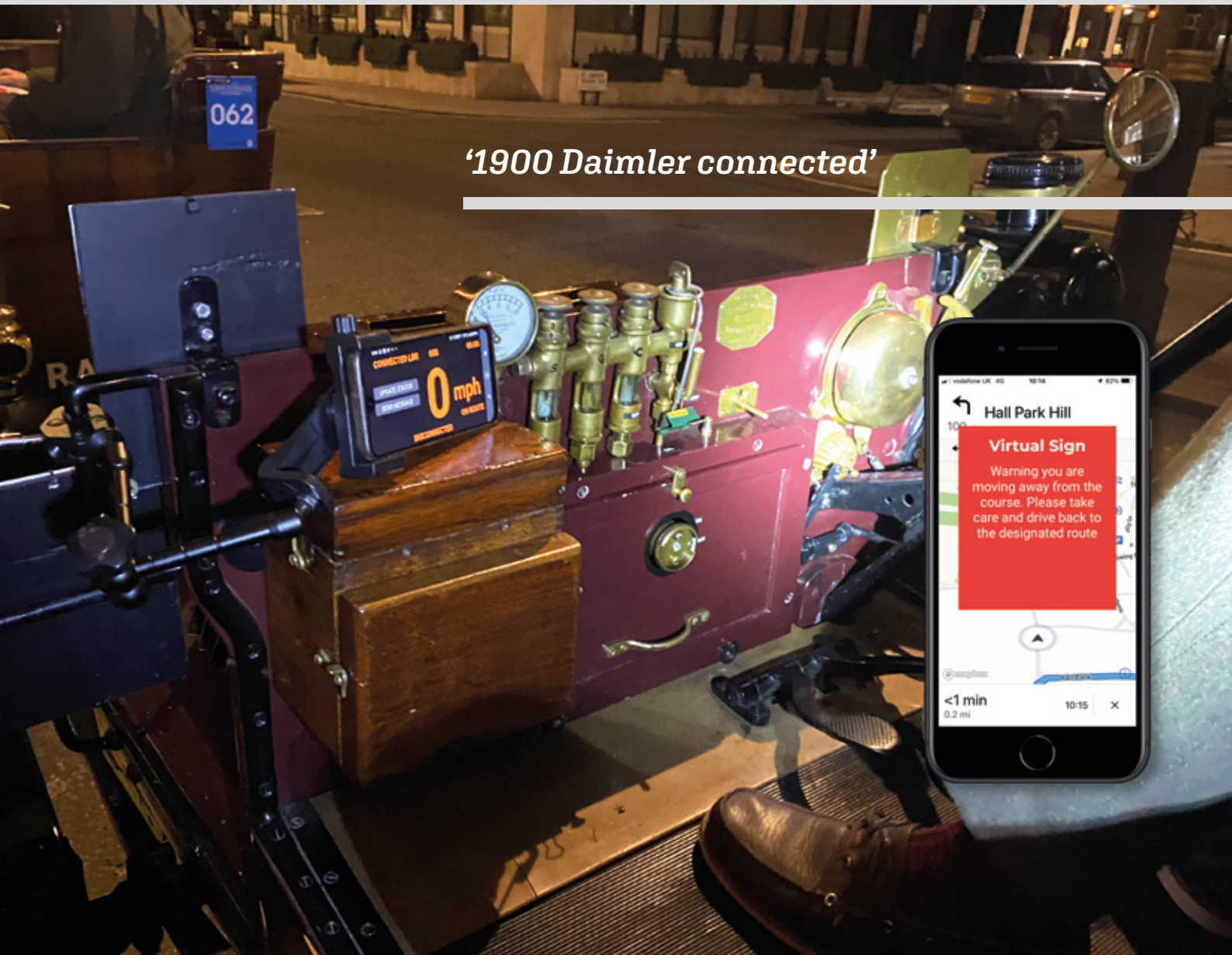
- an Android™ app, designed by KL Systems, that provided in-vehicle messaging and tracking. KL Systems also provided the "back office" for setting signs. This prototype app was designed for the many participants who have entered the run before, and so do not need the sat nav element;

- an Apple™ app, created by Eloy, that provides a fixed-route sat nav aligned to the official route (by no means the shortest or quickest, but optimised for pre 1905 vehicles and their drivers). It had a unique feature to alert drivers should they leave this route, to aid safety. This was designed for the many drivers making their first or maybe occasional run, especially visitors from abroad. It used the same messages as the Android App, and also enabled the organisers to track the vehicles.

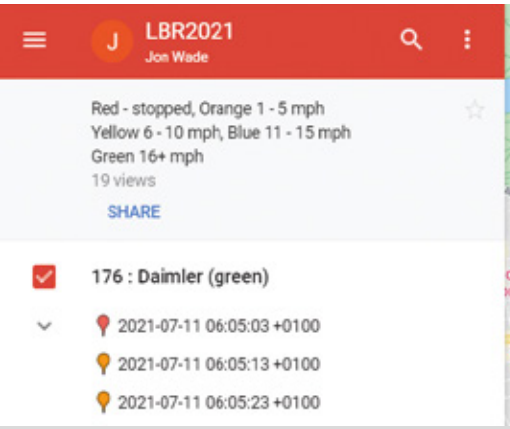
These apps were fed with:

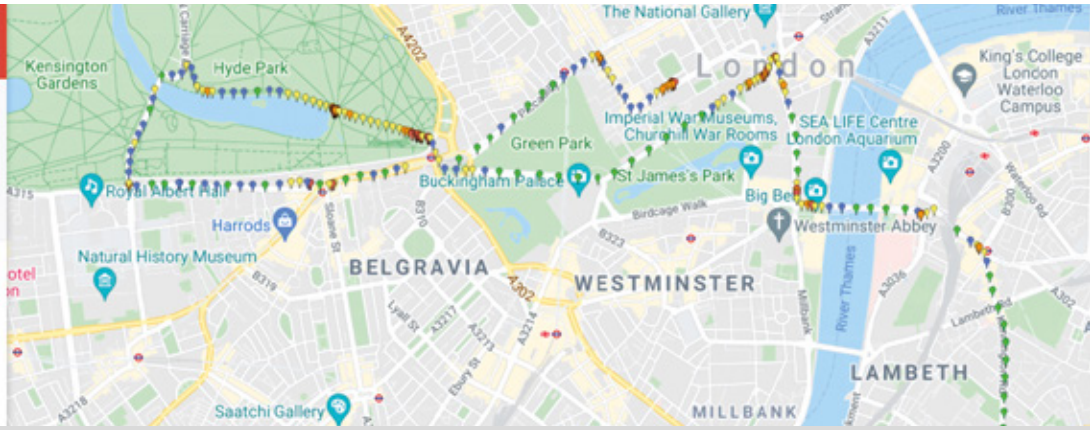
- the messages displayed on temporary signs installed along the line of route (e.g., "Veteran Cars use Bus Lane");
- additional information on fuel and other stops for that day;
- dedicated safety information, for example where participants must not join the motorway;
- roadworks and congestion information sourced from one.network;
- dynamic Congestion information using data from INRIX™;
- dynamic messages to the driver e.g., confirming the route.

The same apps fed back the location of the vehicles onto a web page that showed their location in real time for officials to use.



'1900 Daimler connected'





So what's new here?

None of the technology we used was in itself new – smartphones and smartphone tracking and sat nav are well established, as are Waze™ reports of congestion. Even the potential for in-vehicle signing has been demonstrated before .

But what we did was to integrate all the relevant things into one app designed for a specific customer journey – a phrase much used but, in this case, spot on. For example, the sat nav route was fixed to the marshalled route, and programmed to generate a message if the system detected that the driver had left it. The tracking screen also allowed dynamic in-vehicle messages to be sent, while vehicle occupants could send messages back in the same app. Lastly, we added a large friendly speedometer as the default screen to show the app was still working but also to inform the drivers of pre-1905 cars that didn't have their own effective speedometers already.

Fitting a smartphone to a 1900's vehicle has challenges. There is no USB, cigar lighter, dashboard nor often a windscreen to stick a cradle to. Screwing a 2021 bracket into 121-year-old walnut and brass is unthinkable. So, working with the team at the RAC's motorhouse, and with Ford Model T owner Paul Curtis, we developed two solutions:

- a variety of harnesses which could be used to clamp a smartphone in the view of the front seat passenger, so that the vehicle would be physically connected to the device; and
- customised waterproof clipboards that could securely hold two phones, with battery extenders, to be held by the passenger.

We tested the security of both approaches in test drives. The key was making sure we were not going to do something that would distract the driver and ensuring that the phones could not fall off into the car or into the road. A full risk assessment was undertaken.

We met with the drivers to brief them providing a laminated 2-page briefing sheet on the few things they needed to know, including what to do if things went wrong.

We also met with the course car crew at the Regent Street Motor show, leaving them with a tablet they could use to see live congestion, roadworks and track vehicles from their Hydrogen Fuel Cell Mirai provided by Enterprise.

So, by 6.15 am on Sunday 7 November, all the technology, and all the cars, were ready….

The Royal Automobile Club, Pall Mall

We wanted to show that the tech devices that would make our veteran volunteers connected could actually be mounted on the cars, despite their lack of USB ports, or dashboards, or pretty much any of the bells and whistles of modern motoring.

And we did. Brackets had been designed for each of our three volunteers that worked with their layout and used film-maker quality kit (think 'how can we see Jeremy Clarkson doing 200mph while driving?' rather than a high-street sucker-mounted phone holster). The apps were installed – the system was working.

For future events we are confident that vehicle-fitted harnesses could be installed that could cope with the shake, rattle and roll involved in driving such old cars.

But back to the 2021 run, and having established that devices could be mounted onto the cars and connected via our bespoke apps, we switched to the weather-resistant clipboards we had sourced to give to the front-seat passengers of each car which carried the two smartphones, plus battery boosters, needed to test the two apps per vehicle we had designed.

A quick handover and briefing to the passengers, and then to the smell of coffee, kedgeree and warm oil, the three cars set off for the start line.

We tracked the cars on-line from the Transport Technology Forum (TTF) chase vehicle which was also equipped with the apps, tracking and cameras, as they made their way to the traditional start line. With four connected vehicle experts (Andy, Darren Capes from DfT, Paul Hutton from ITS(UK) and Iain Macbeth from Enterprise) on board, it was reported we looked like the Ant Hill Mob from Wacky Races. And being now connected, the vehicle occupants received specific messages about how to best to access Hyde Park. The connected veteran vehicle dialogue was working, and working well.

'We watched as the three Club cars joined over 200 others in a well-managed flow out of Hyde Park.'

Hyde Park

The trackers embedded in the apps enabled us very swiftly to find our three Club cars at Hyde Park. All the users professed themselves happy with the messaging so far, and confirmed that no issues of safety had emerged (we had previously undertaken a full safety risk-assessment).

And so we watched as the three Club cars joined over 200 others in a well-managed flow out of Hyde Park. We kept the apps running all the time to check data before the start – more about that later.

As the three RAC cars left Hyde Park, we then followed the route out of London via the Mall, Whitehall and Westminster Bridge but then switched in the TTF chase car to a standard sat nav (fed with data from modern connected vehicles) to guide us onto the swiftest route to the Crawley "pit stop", since our 21st century car had no issue with steep gradients and could use the M23 safely.

En route

There were several sets of roadworks *en route*. Our apps picked up real-time data from the one.network feed to warn participants about what was up ahead.

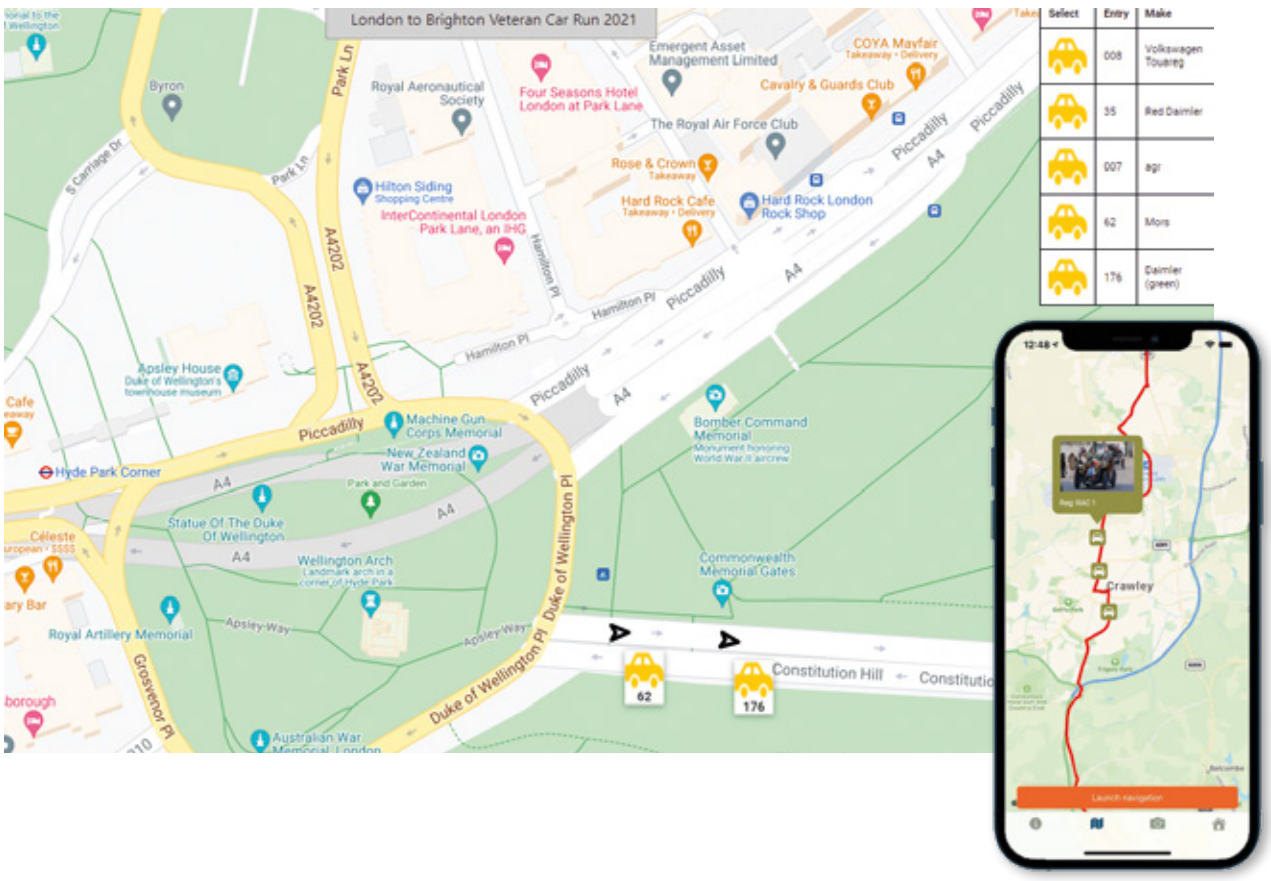
We were delighted to see so many people at the side of the road enjoying the Autumn sunshine, watching to see which veteran car was about to pass them. For future years we are considering how best our apps could not only inform participants and marshals, but also be used to generate information for the thousands of enthusiasts lining the route.

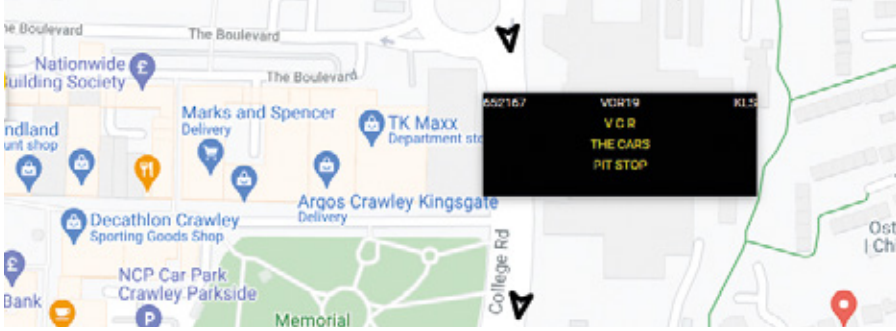
The TTF team monitored for congestion using INRIX and one.network and sent messages to the Club vehicles. Had there been a need to change route (e.g. due to a road closure) we could have used the apps to inform the drivers - thankfully it was generally a smooth and sunny route this year.

Our first key learning point was at Coulsdon. The route suggested on the sat nav-based app deviated from the actual physical course for about half a mile. This was because we did not have access to the detailed route maps until two days before the event and so we had to employ our best estimates of the route from the schematic maps available to spectators. Happily, before the drive, we had instructed the drivers to ignore the sat nav if it contradicted a marshal's advice, so no harm was done, but this lesson will apply for any connected vehicle – good, timely data from the operators of roads is vital, whether you're driving a veteran car to Brighton or simply relying on your sat nav to get to an important business meeting.

Where the A23 splits into the A23 (the London-to-Brighton Route) and the M23 (not the route, and a hazard if chosen), we paid particular attention to advising participants on the right lane choice, to support the extensive fixed traffic management in place with bollards and physical signs.

The course plan suggested several variable message signs (VMS) would be set, so we mirrored in the information provided through the app the messages they would have sent, although it transpired on the day that not all the VMS units were in place or operational. A key learning point for future runs is that our ability to send key information directly into participants' vehicles lessens the reliance on roadside VMS.





Crawley

The "pit stop" at Crawley is far more than that. 1900s vehicles need fuel, water, and some serious fettling if they're going to make it all the way to the coast. Once again we were able to find the Club cars easily in a very full car park due to trackers embedded in our apps.

The red Daimler, the oldest car, had broken down due to a crankshaft fastener issue. Skilful mechanical wizardry, some wire and some ingenuity fixed that. But more worrying was its petrol leak. Expert attention from Michael and the Mechanics soon got them on the road again, although the car's continued participation was now "hanging by a thread."

Quickly catching up with the cars through being able to use the motorway we found that one of our two apps, the sat nav based solution on the iPhone, had very quickly run out of battery. Sat nav mobile apps do tend to drain a lot of battery – about 30% to 40% per hour. In addition, we had left both of the apps on before the start (over an hour), collecting a great deal of tracking data that, with hindsight, we probably didn't need. The standby battery wasn't able to charge as planned, and the power drain on what were older Iphones meant that one of our two apps conked out - a lesson for future events. But the android app, without the sat nav, kept running right the way through.

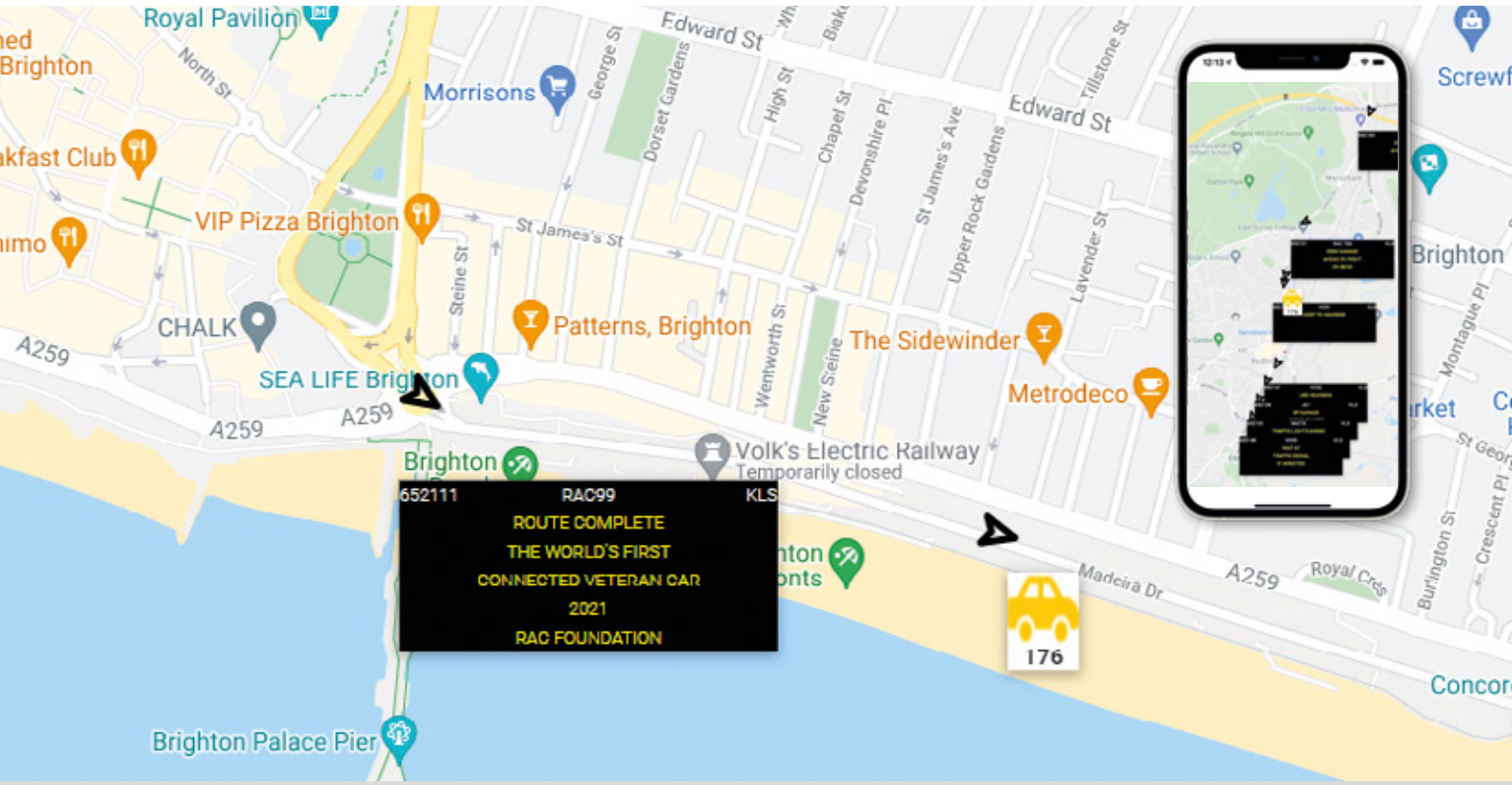
The vehicles had to take the correct lane at Pease Pottage and also navigate through new housing access roads built since the last run, so it was helpful that our app data was able to supplement the fixed signs and the marshals, whilst showing us that the vehicles had all taken the correct route. This tracking of key points along the route could be invaluable for future events.

Approaching Brighton

The end of the 2021 run was coming into sight as the cars arrived at the outskirts of Brighton.

Where the route joined the fast multi-lane A23 into Brighton one lane had sensibly been coned off for the veterans to be segregated from other traffic. Largely the 'virtual signing' through our app mirrored this, but one physical sign wasn't placed consistently with the layout of the cones; by editing the messages going to the cars in real time we were able to clarify what the drivers should do, demonstrating the value of dynamic-in-vehicle as opposed to fixed signing.

While the veterans made their way along the planned route, we were able to use the motorway to make up time, but not so much as to match the time of Duncan Wiltshire who arrived on Madeira Drive in the 1903 Daimler having topped 43 mph (as read from our app), the first of the three Club cars to cross the finish line.



Madeira Drive

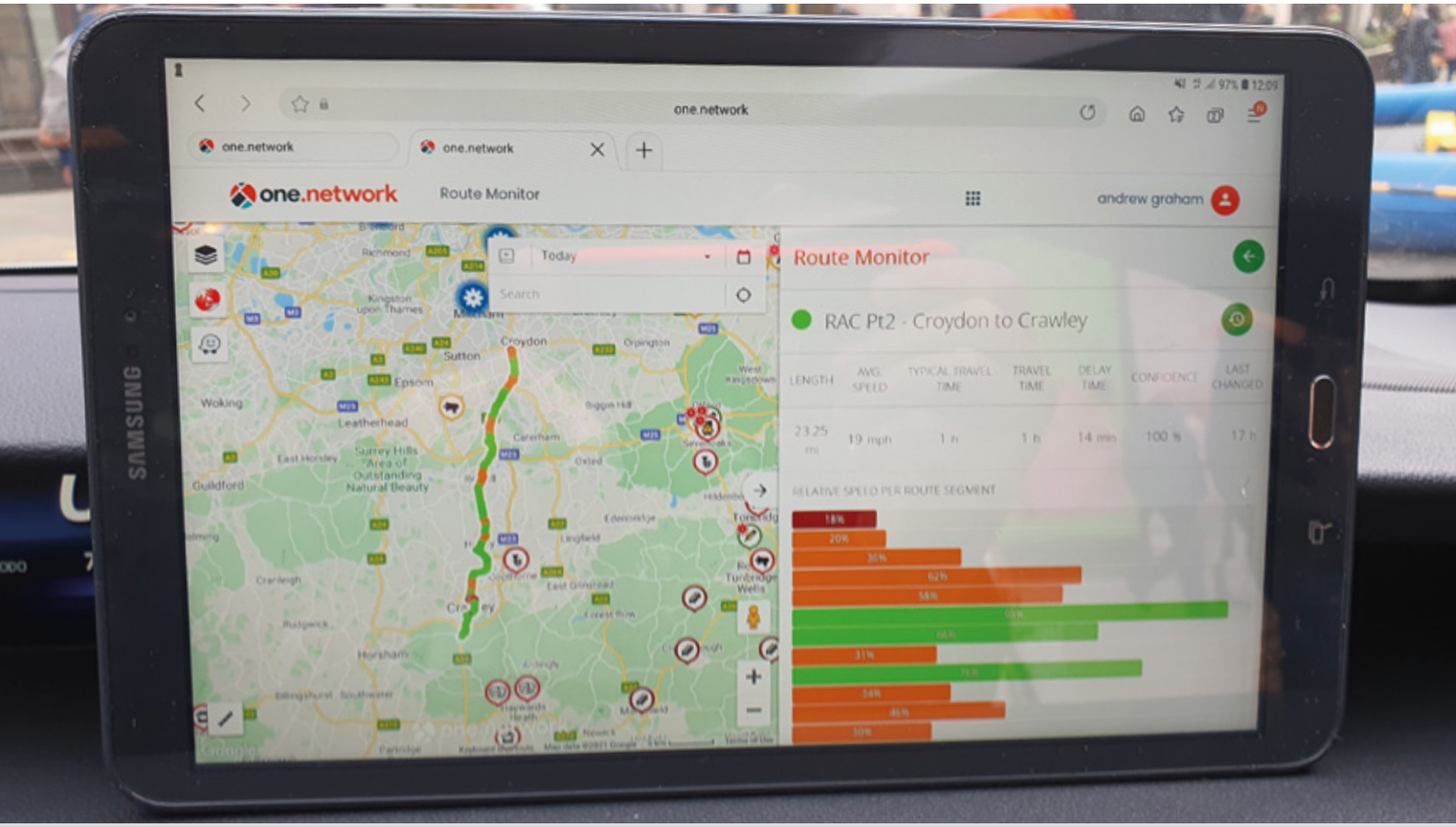
Down on Madeira Drive we caught up with all the drivers and crews.

Our participants were generally delighted with the pathfinder and saw real value in its further development for future years, especially for drivers new to the route. They found both apps easy to use (despite having just a few minutes' briefing in the morning cold and dark).

After several weeks of hectic coding, phone configuration, chasing information and testing, we were happy to savour the moment and the fabulous atmosphere in the Autumn sunshine - celebratory ice creams all round - as we reflected on the fact that we had created the world's first connected veteran vehicle event.

The image below shows on a tablet screen a 'dashboard' of information that could be available to the stewards and those in supporting vehicles. The display shows live, real-time information about roadworks and congestion.

This real time "floating vehicle" speed information, from one.network, is sourced from a combination of more modern connected cars and people using TomTom route mapping (which includes apple maps and iPhone tracking data).



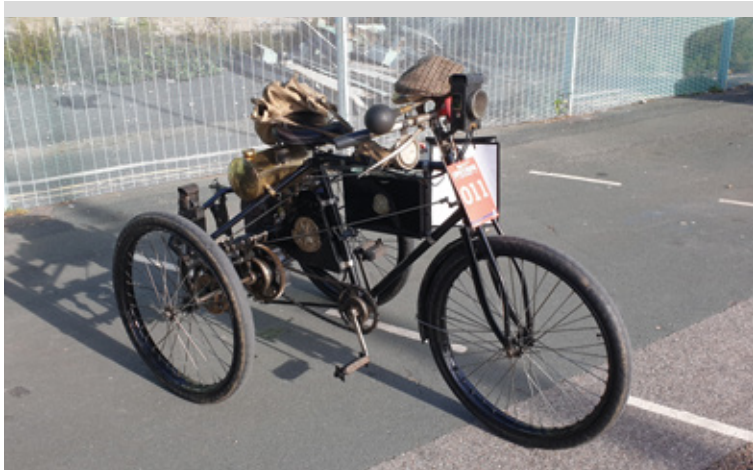
So what?

This pathfinder wasn't just about veteran cars.

It demonstrated that any vehicle - or indeed moving thing (horse rider, e-scooter, bike, motorcycle, combine harvester, traction engine…) - could broadcast its location in real time, potentially enabling it to live in a mixed traffic fleet including highly automated vehicles, and receive information that could inform a driver or an automated driving system.

Beyond that, the research value was that we found:

- Cellular connectivity was good enough for the uses we wanted and where we could test it – despite many thousands of people on the Brighton Sea front, we were able rapidly to get data from vehicles;
- There is a real need to engage with road operators to ensure consistency of in-vehicle and roadside data to ensure a consistency of messaging;
- Connected cars don't need to be new ones, although we did use the app in a Hydrogen Fuel Cell Course car too.



We also learnt a great deal about at-scale connection between roads and vehicles that will be pursued by the Transport Technology Forum in its future work.

What did we learn?

- The most important thing we established was that it is possible to bring a bespoke suite of connected car functions together into a single integrated app. This combines specific routing information and the facility to communicate real-time information to and from the vehicle – all of the functionality we provided could have been sourced via various different apps but none could offer the combined product that we developed for the London to Brighton run;
- Such an app can support and augment the marshals' activity by providing a channel to give advance warning of directions and route changes, for both seasoned drivers and new entrants, that can be updated real time;
- There are ways to safely mount a smartphone onto a veteran car, but the weatherproof clipboard approach works well, and would have been invaluable had the weather been unkind;
- Data generated from vehicles could be very useful, particularly to monitor their location, (e.g. in the event of breakdowns, but also to track progress in terms of traffic speeds);
- With some tweaks a self-service app such as we designed could be made available to all participants to run on their own smartphones for future events – or similar events.

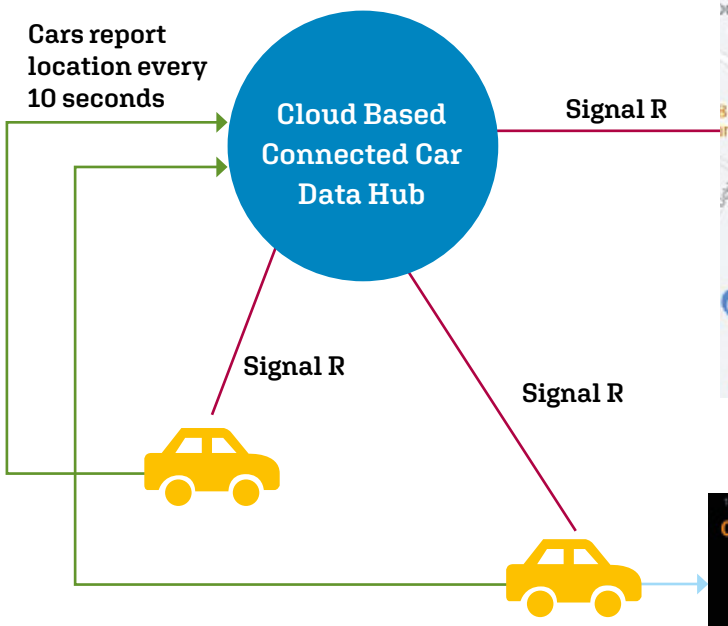
Some things need fettling:

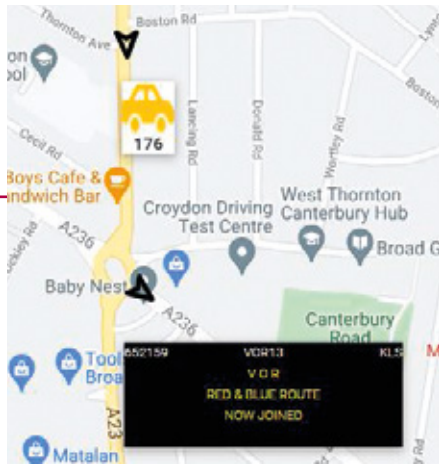
- It is important to get early sight of planned route details and associated signing plans, and to be able to check them via the first course car running on the day (since it never goes quite as planned);
- The choice of mobile smart-phone devices is key – in particular their functionality in terms of battery life and ability to accept booster power;
- There's work to be done to improve the design of on-screen information for those in tracking vehicles and on mechanics' phones;
- Future iterations need to generate a tracking alert if a vehicle has stopped for more than a few minutes, and show how to interpret such data as is still coming through;
- Some work is needed on timing of message displays based on the speed data collected in 2021 – some areas we thought would be slow weren't, and vice versa.

Appendix

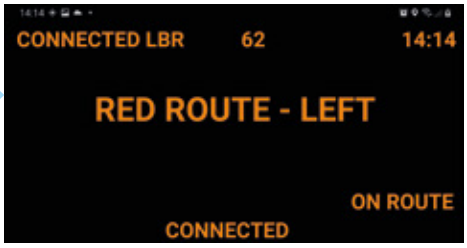
KL Systems provided the Android App, cloud based back-end systems and Web graphical user interface. This was a customised version of the service KL Systems has developed to support testing and trials of connected vehicle technology.

System Overview





Google Maps - Hub Connected GUI



The diagram above shows the general arrangement, a cloud-based data hub maintains details of car locations and virtual message sign settings. An android app, which by default displays the car's speed, reports every 10 seconds the location and speed of each car to the hub. The hub maintains a set of virtual message signs (virtual VMS) - these are geospatial information points at key locations along the route, the virtual VMS are kept constantly synchronised with the app. As the car approaches a virtual VMS, the message is spoken and displayed on the screen (as illustrated above).

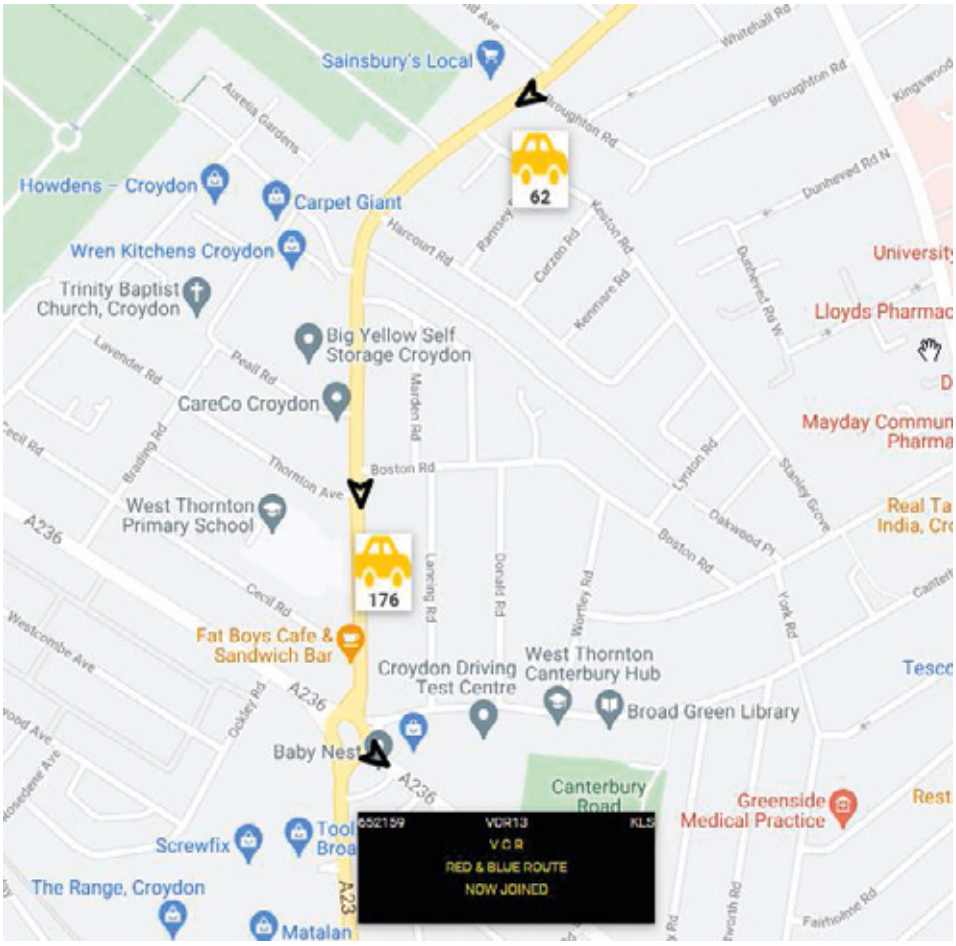
In addition, for the London to Brighton Veteran Car Run the system tracks cars providing the clerk of the course visibility of car location and status together with a capability to exchange information (only when the vehicle is stationary).

A web accessible interface Allows Virtual VMS messages to be updated, created and deleted using a point and click interface. An updated message is in the car within 1 second of it being entered or modified.

Point and click creation of Virtual VMS

Map GUI with car Location and direction of travel

Displays the position of each car dynamically on the map.



Displays a list of all the cars tracked which allows the map to be centred on the position of a selected car.

Select	Entry	Make	Status	Message
	008	Volkswagen Tourareg	ON ROUTE	2 mph
	35	Red Daimler	ON ROUTE	0 mph
	007	agr	ON ROUTE	2 mph
	176	Daimler (green)	ON ROUTE	19 mph
	62	Mors	ON ROUTE	19 mph

Shows the make and model of each car and its speed.

	176	Daimler (green)	ON ROUTE	19 mph
	62	Mors	ON ROUTE	19 mph

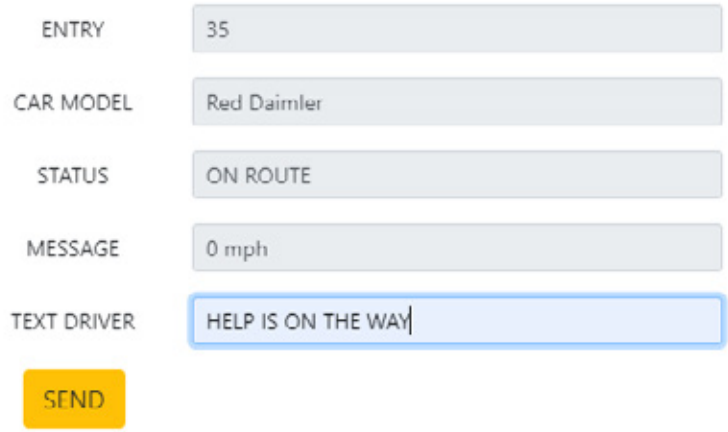
Shows the run status of a car on-route, broken down, retired or completed and colour codes the status on the map Yellow - on route, Red - Broken Down, Blue -Retired, Green - Completed .

	176	Daimler (green)	ON ROUTE	19 mph

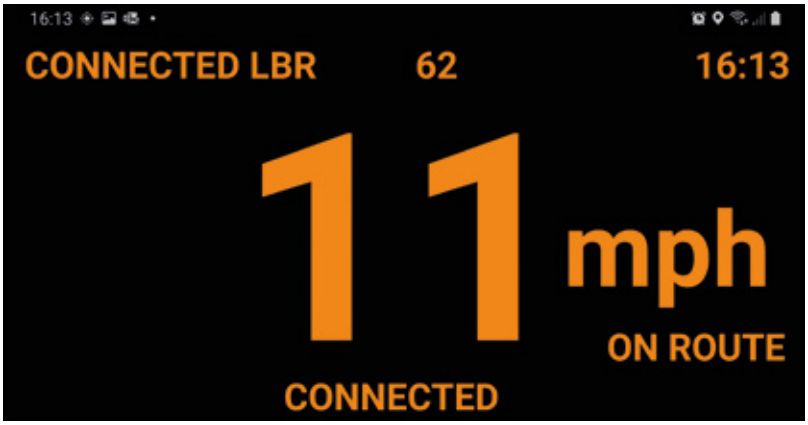
If sent from the app shows a message from the car.

	62	Mors	completed	Well Done

Allows a message to be sent to a car by clicking on the car icon on the map.

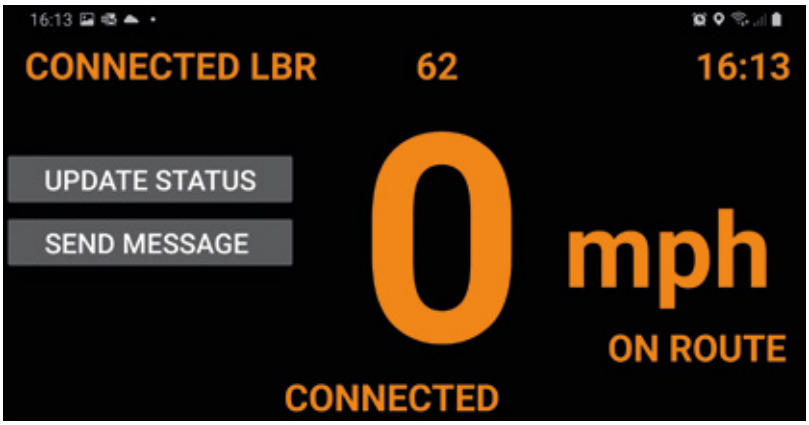


An Android Car App which by default, displays the car speed, its status on the run and confirms connectivity to hub (CONNECTED). The status changes to DISCONNECTED when there is no cellular mobile data link available.

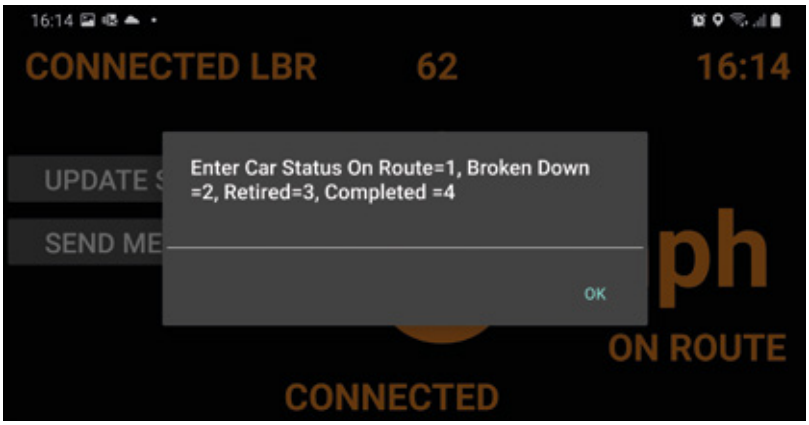


Displays and speaks Virtual VMS messages as the car encounters them on route.

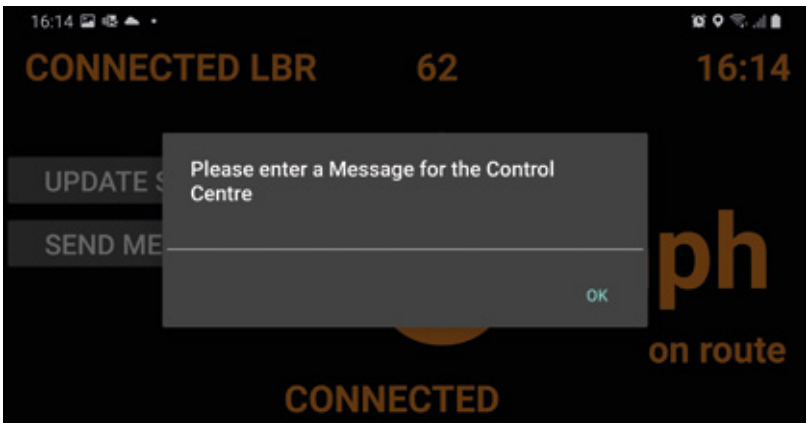
When stationary allows the driver/ navigator to update the car's run status and send a message to the clerk of the course.



Update the Car Status.



Send Messages to the Control Centre.

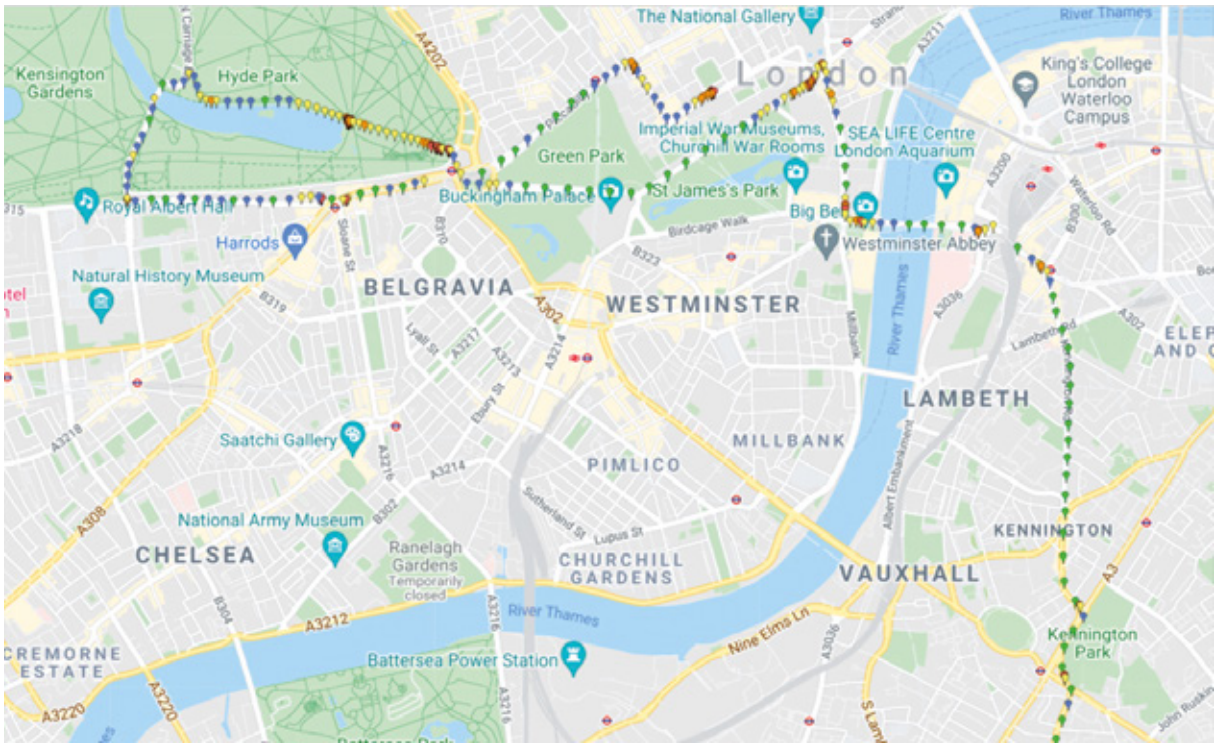


Display a message from the control centre.

Back End Server - Logging

Each 10 second position update from the cars is logged on the cloud server for later review (simple csv format). See below a visualisation of the log (Red stopped, Orange 1 to 5 mph, Yellow 6 to 10mph, Blue 11 to 15mph, Green 16mph +.

176 Green Daimler - Start of Run in London



Thanks to Jon Wade for processing of data from the log for display.

Eloy and the World's Oldest Connected Car

Eloy's Apple iOS app along with KL System's Android app demonstrated how mobile technology can be used to inform drivers of even the oldest cars about road conditions, accidents, and traffic, as well as ways to build new sat nav based solutions to improve our in-car experiences.

Across both mobile apps, we had a number of technologies at our disposal. This included in-vehicle signage, speed display, sat nav, vehicle tracking, and numerous ways to override standard app modes. In the Eloy app, we also have a feature where we can build extensions for 3rd parties which meant the RAC LBR could sit within its own standalone area.

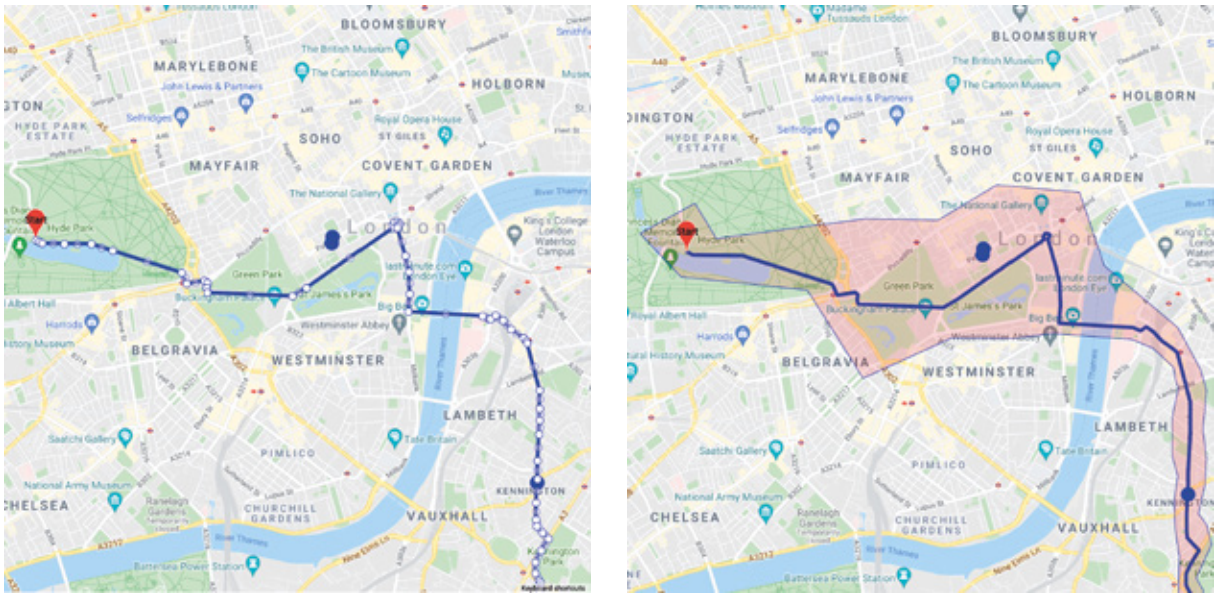
For the pathfinder we focused on building a fixed route from London to Brighton and providing messages to drivers if they went off course, as well as supplementary information such as locations of petrol stations, traffic pinch points, and lane guidance. We locked the sat nav to a specific route, so re-routing would not send participants on the wrong roads, and made this as close to self-service for the race organisers via Eloy's back-end web solution. Messages were supplied by the KL Systems hub.

Adjusting the sat nav for fixed routes

There were 2 important components to this. Firstly, we built a tool so that LBR management could plot a route using waypoints. Eloy used this to override the sat nav forcing it to show the defined route and avoid re-routing. Participants were then able to follow a single blue line on the sat nav which included turn-by-turn navigation.

Secondly, a geofence was created that surrounded the route with a 100m radius. This allowed us to create additional triggers for in-vehicle signage (IVS) that I will discuss next. The aim of these warning messages was to instruct drivers to return to the fixed route (the blue line), if they go off course.

Plotting the fixed routes with waypoints for fixed navigation and the geofence that surrounds the route to trigger warnings



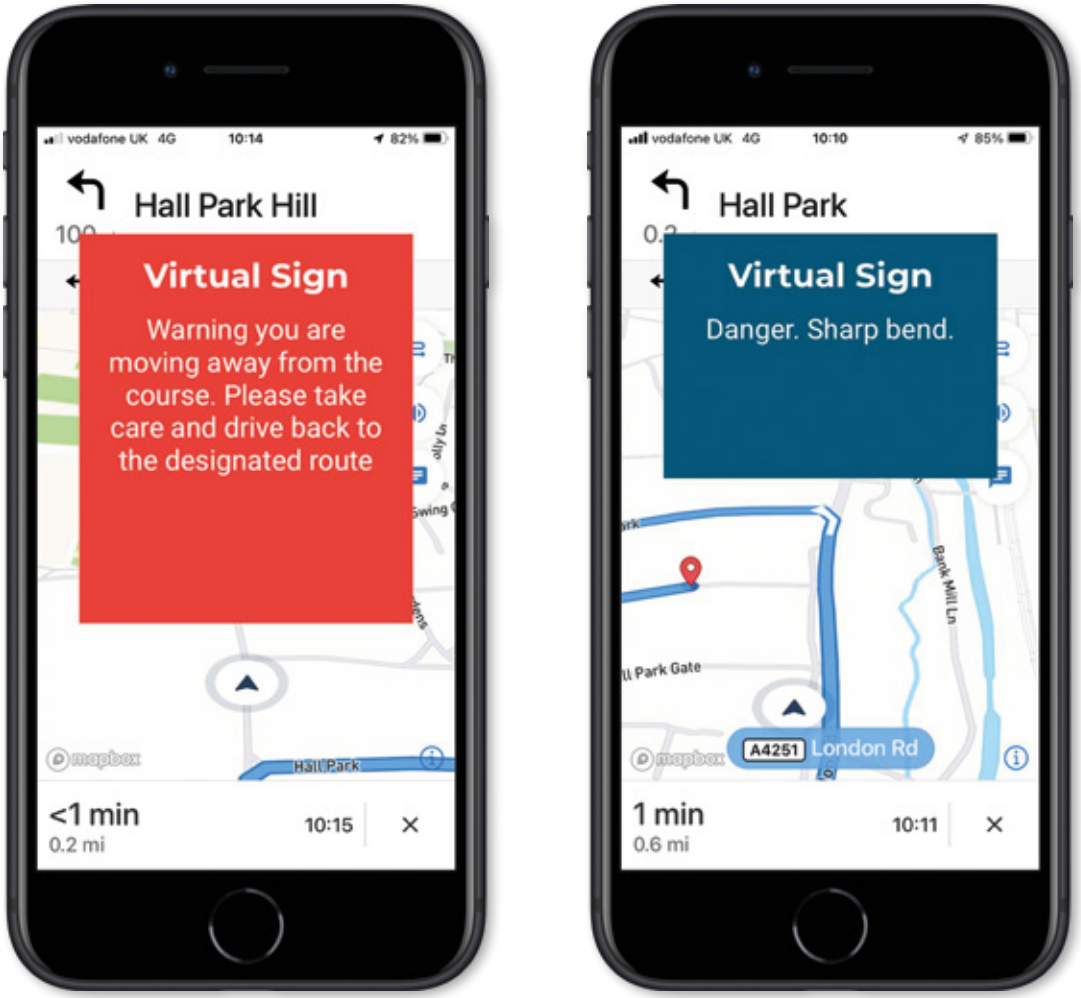
In-vehicle messages

There are currently 3 types of messages we send to users of the Eloy app:

- Turn-by-turn navigation instructions
- Messages sent by IVS that includes guidance and safety information such as where to stop for fuel, rests, and food, or where to get a push or a tow
- Warning messages sent by IVS, including going off route

Note that all messages are also audible using our proprietary text-to-speech technology.

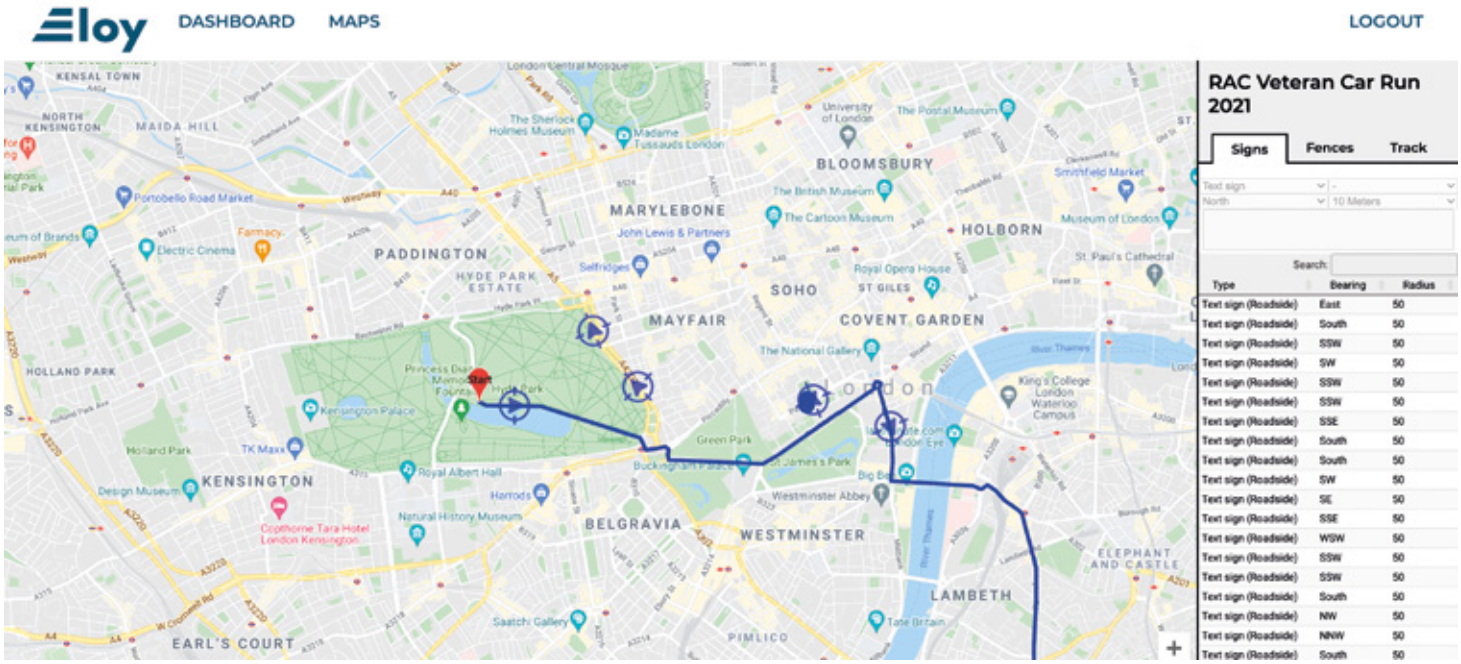
Two types of in-vehicle messaging used for the event. Red danger warnings associated with going off-course and blue are advisory information



Vehicle Tracking and Event Management Overview

The final piece in our app was setting up live vehicle tracking so we could record the routes taken by participants. This allowed us to enable live event management from a central control, as well as the ability for a post-event review to help with future planning.

Online platform for managing the event, tracking vehicles, plotting routes, inserting in-vehicle digital signs, and creating geofences



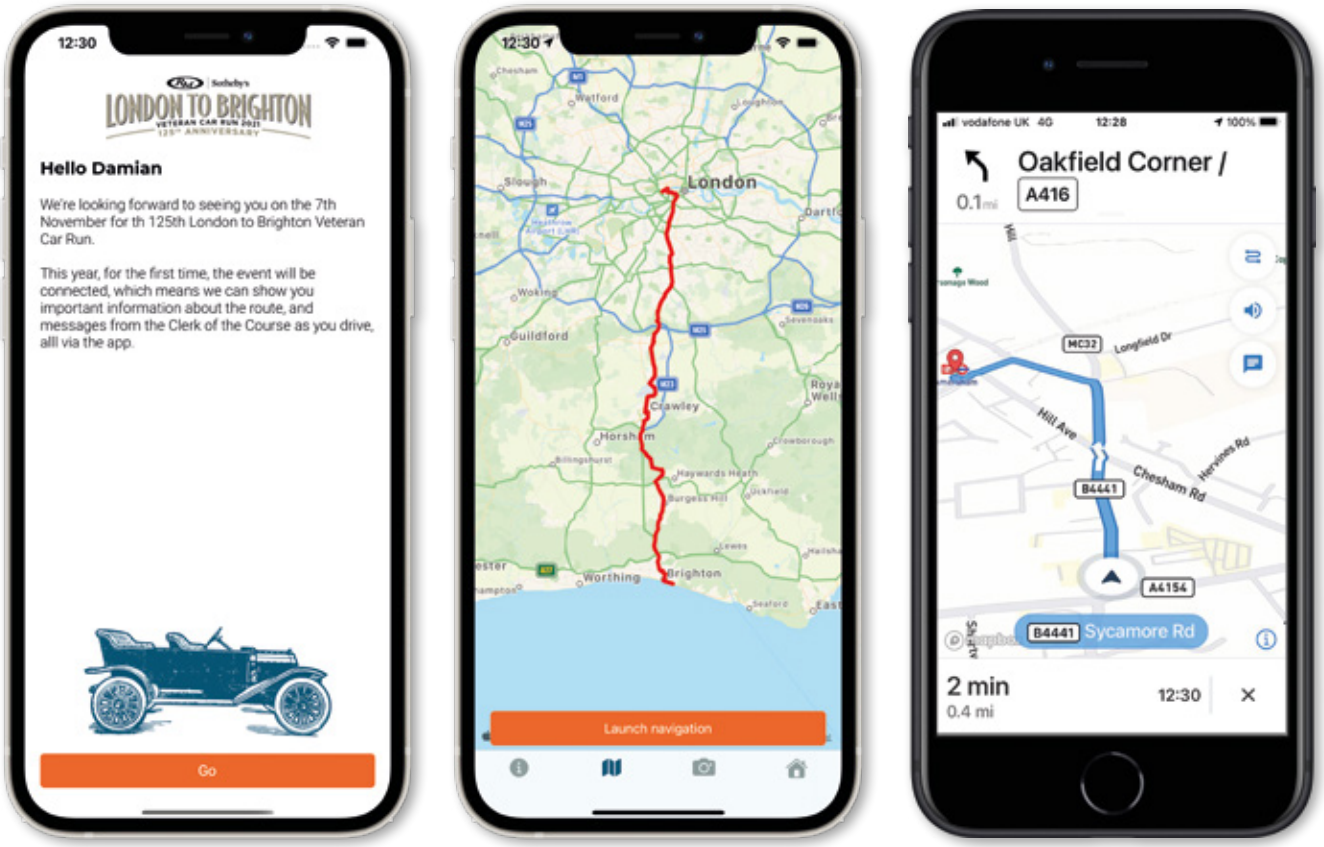
We think an app to support the VCR has great potential and could also form a digital guide for spectators along the route. Eloy's app is publicly available and can be accessed at: **https://apps.apple.com/gb/app/eloy-drive/id1498462831**.

User Journey

After downloading the Eloy app, users can easily access the VCR Extra from the home screen.

There is an introductory event page, then a route overview from which users can launch the fixed route navigation. IVS are displayed over this route, as drivers travel along it.

User journey in the Eloy app. Orange button progresses to the right



The Transport Technology Forum (TTF)

Funded jointly by the Department for Transport and Innovate UK, the TTF exists to provide leadership, direction and support and to stimulate investment in innovation and technology solutions specifically encouraging the adoption of initiatives to improve traffic flow (and mitigate the negative impacts of traffic) through better road network design, operation and management.

TRANSPORT TECHNOLOGY FORUM

RAC Foundation

Mobility • Safety • Economy • Environment

The Royal Automobile Club Foundation for Motoring Ltd is a transport policy and research organisation which explores the economic, mobility, safety and environmental issues relating to roads and their users. The Foundation publishes independent and authoritative research with which it promotes informed debate and advocates policy in the interest of the responsible motorist.

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