

VENTURER

Trial 3 Bus Demonstration

Spring 2018



Member of the SNC-Lavalin Group



University of
the
West of England



Bristol Robotics Laboratory



What is VENTURER?

VENTURER is a £5m research and development project funded by government and industry and delivered by Innovate UK. Throughout the project's three-year lifecycle, the potential future of Connected and Autonomous Vehicles (CAV) is being explored through a series of road and simulation trials, research into public acceptance, investigation of technical challenges, and studies of the insurance and legal implications.



Trial 3: VENTURER Bus Demonstration

In March 2018, VENTURER undertook the UK's first on-road demonstration of a driverless car interacting with a bus in South Gloucestershire. The ability for driverless cars to interact safely with stopped and moving buses is a crucial requirement prior to safe deployment of autonomous vehicles onto UK roads as it is typical situation that occurs on a regular basis, especially in urban areas.

The demonstration's focus centred on the capabilities of the connected and autonomous technology.

Component	Research Question
Integration of DMS, sensors and Wildcat	Can the integrated AV system accept and act upon information communicated from another vehicle?
Communications System	Does the communications system successfully share data in a real-world CAV situation?

Where did we do it?

The demonstration took place on Long Mead in South Gloucestershire (Figure 1). Long Mead is a 30mph bus only road (in both directions) and is located to the south-west of UWE campus, a short walk from Bristol Robotics Laboratory.

There is a pedestrian footway along the entire length of the road on the south side; on the north side, the footway starts near the junction with Platts Wood and runs east to the University campus.

Figure 1: Long Mead location

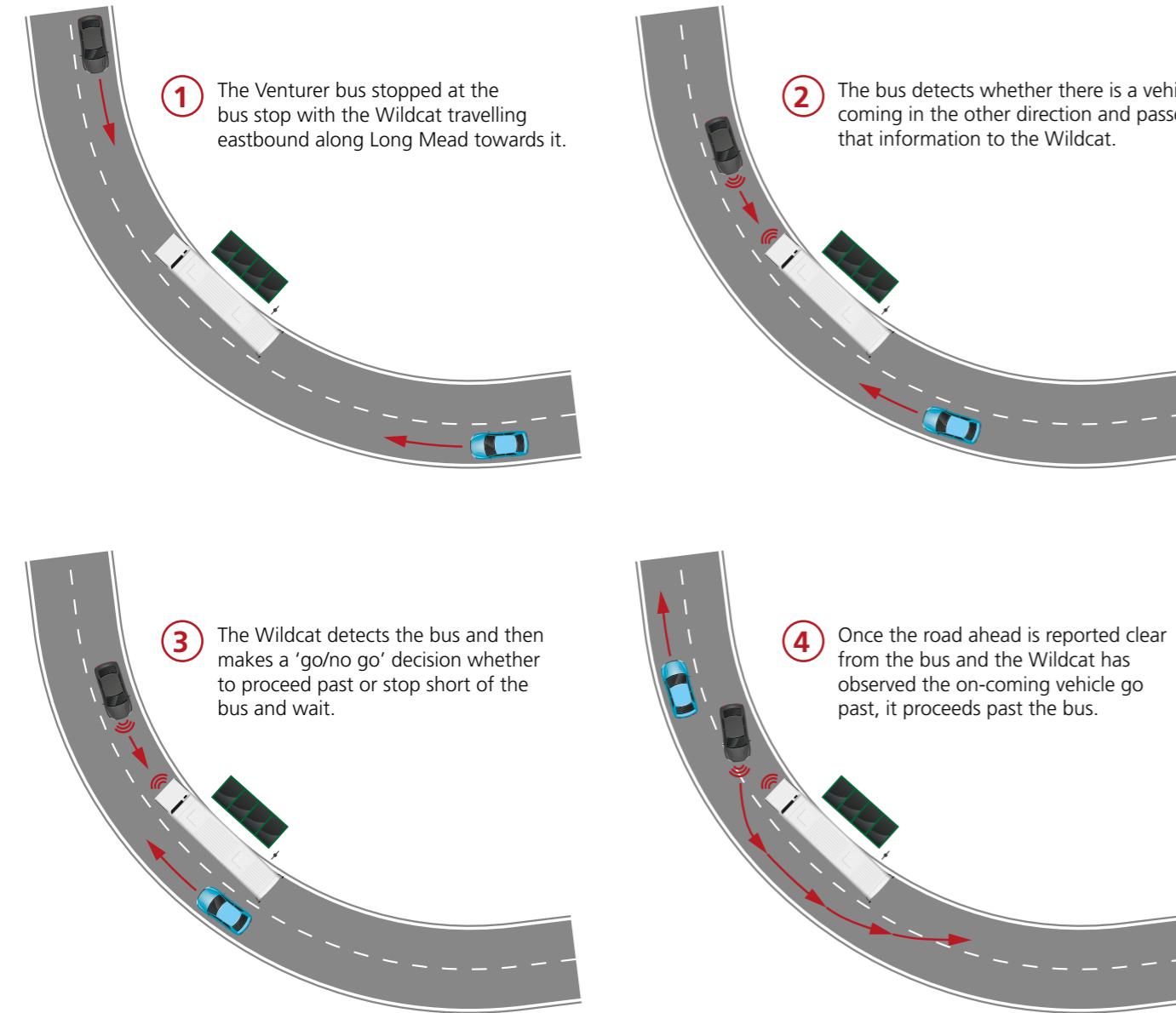
The trial was designed so that all autonomous driving would occur in the eastbound direction meaning that the vehicle could not be directly next to pedestrians at any time. This also meant that the trial benefitted from occluded sight during the approach to the bend in the road, enabling the use of the 'look ahead' functionality.



Experiment Design

The demonstration involved testing a 'look ahead' functionality, where the autonomous system, including sensors, a wireless communications system and the vehicle's Decision Making System (DMS), enabled the Wildcat to be notified that the road ahead was clear so then the vehicle could safely navigate around a stopped bus despite having obstructed vision.

Figure 2: 'Look ahead' demonstration



Another scenario was undertaken when there was no oncoming vehicle and the Wildcat was able to make an immediate 'go' decision to continue around the bus without the need to stop.

Figure 2 shows the overtaking scenario using the Wildcat's 'look ahead' capability.

How did we do it?

The bus demonstration was delivered collaboratively by the VENTURER partners during the beginning of 2018.

Technology aspect	Provided by...	What it does
Wildcat	BAE	The Wildcat is VENTURER's autonomous road vehicle. It is a bespoke Bowler Wildcat and is shown below
VENTURER Bus	First	First provided the use of a bus for the purpose of the demonstration. It was retrofitted with VENTURER sensors and a communications system.
Decision Making System (DMS)	Bristol Robotics Laboratory	The DMS is located onboard the Wildcat. The DMS framework uses a flexible behaviour tree which was tested at VENTURER's second showcase.
Communications system	University of Bristol	The Vehicle-to-Vehicle (V2V) communications system was set up on the VENTURER bus and enabled the wireless transfer of raw data from the sensors on the front of the bus to the DMS onboard the Wildcat.
Sensors	Fusion Processing	A radar unit provided by Fusion Processing was fitted inside the front window of the VENTURER bus. This provided sufficient range to detect oncoming vehicles and communicate this to the waiting Wildcat via the V2V communications unit.

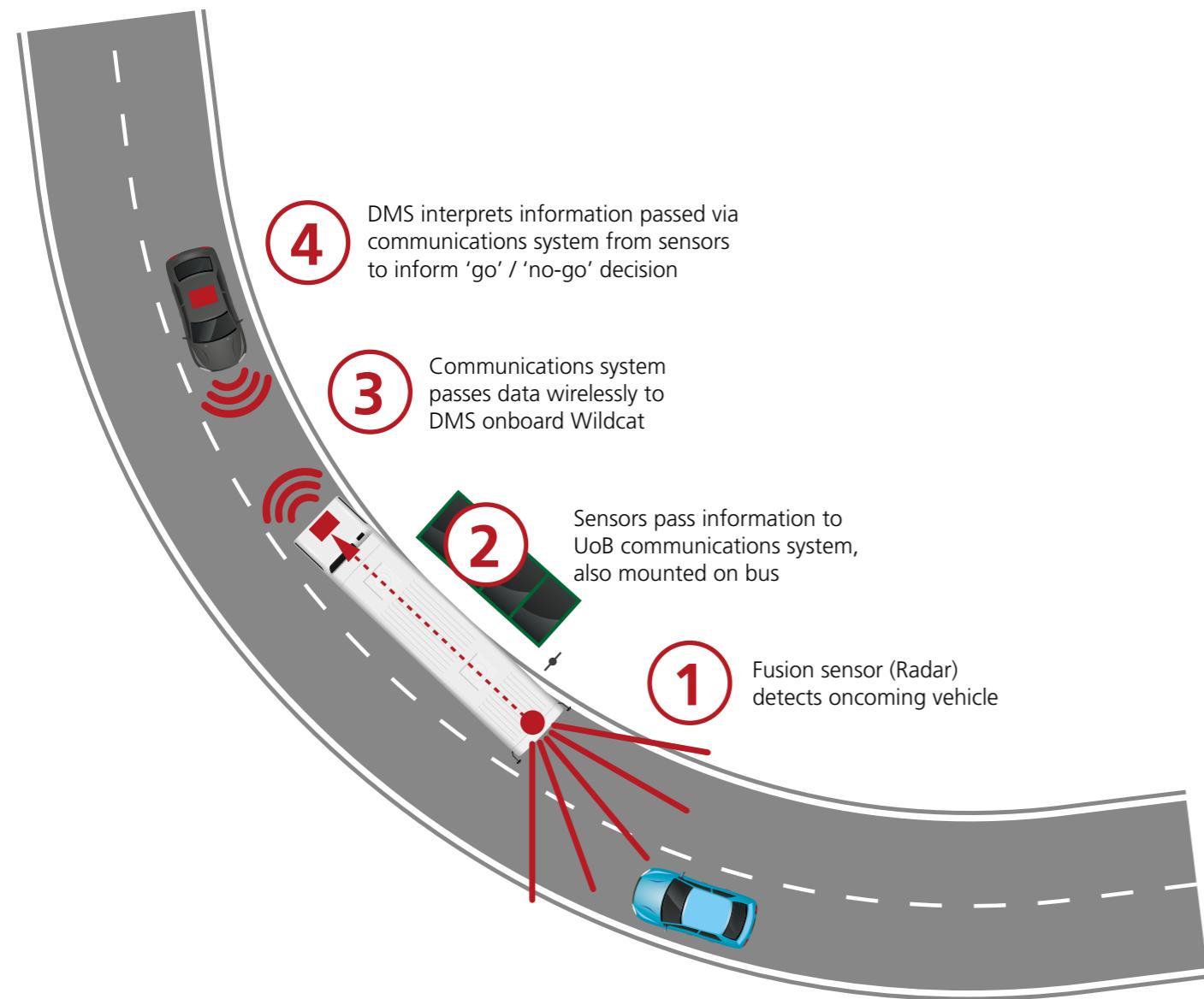
Figure 3: Wildcat and VENTURER bus



VENTURER also used a timeout facility to represent the scenario in which an on-coming was detected, but then never drove past. For example, if it parked short of the bus or turned into a nearby road junction. In this circumstance, the DMS would command a slow drive past the bus, limited by its own sensors, after a prescribed period of waiting.

The diagram below shows how each item of technology interacted to form the overall AV system enabling the 'look ahead' demonstration.

Figure 4: Technology interaction



Pathway to Driverless Cars, DfT <https://www.gov.uk/government/publications/driverless-cars-in-the-uk-a-regulatory-review>

What did we achieve?

Component	Research Question	Outcome
Integration of DMS, sensors and Wildcat	Can the integrated AV system accept and act upon information communicated from another vehicle?	Yes. During preparation for the demonstration, we tested and proved the ability of the sensor unit to communicate with the DMS onboard the Wildcat via the wireless communications system. This enabled the Wildcat to act upon information provided by the bus.
Communications System	Does the communications system successfully share data in a real-world CAV situation?	Yes. The communications system was set up on the bus and successfully shared data throughout the testing.

VENTURER believe that this aspect of Trial 3 demonstrates great project progression and puts the West of England at the forefront of CAV testing in the UK. To our knowledge no other UK CAV projects have yet tested autonomous technology interactions between a CAV and a bus.

The bus demonstration represented a step change in technical, safety and management challenges due to its location on an open road and the resulting potential for interactions with members of the public and their vehicles. The success of the demonstration shows the successful collaboration between VENTURER partners to deliver safe and innovative real-world tests of a range of connected and autonomous technologies.

What's next?

VENTURER's trials and demonstrations have been considering how CAV technology can interact with other road users and in typical highway scenarios, to assess the acceptability and feasibility of deploying autonomous vehicles onto UK roads.

The bus demonstration has shown an example of how connected and autonomous technologies can be used on different types of vehicles to complement and support the safe performance of CAVs as part of the wider transport network. The demonstration was one of the first explorations of the interaction between connectivity and autonomy, with many other trials in the UK focusing on either connectivity for driver advisory systems or autonomy for self-contained automated driving.

The successful integration of V2V communications into the VENTURER autonomous system indicates how CAV technology could be used in future research to test additional functionality. On buses, this could include detecting door closing or indicator use on the bus to communicate with other vehicles when the bus is about to pull away, this technology is transferrable and could also be used on other vehicles or roadside infrastructure as well.

Further research around this topic will help to develop specifications for Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication systems to ensure that all modes of transport are able to cooperate successfully in the future transport network. Additionally, exploration of the interactions between connected features and autonomous systems may also raise interesting contextual questions around liability, organisation, and security. VENTURER supports this and anticipates working with government and industry to help inform future policies and regulation on how all vehicles may interact with each other and infrastructure in a transport network with CAV capabilities.



A Trial 3 film including footage of the VENTURER bus demonstration in action is available on the VENTURER website:

www.venturer-cars.com

Further information on trials, public demonstrations and blogs are also available on the VENTURER website, and you can follow us for updates on Twitter:

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