GSMA
Foundry

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CASE STUDY

Self-driving Shuttle
Gears Up for Expansion

Successful two-year trial of a connected autonomous vehicle exploits combination of cellular and satellite technology

Highlights

- UK trial of self-driving shuttle bus harnesses 4G, 5G and satellite tech for continuous connectivity
- Developed by Darwin Innovation Group, the connectivity enables the bus to be tracked precisely and the transmission of live telematics data required for regulatory and insurance purposes.
- After adding a second shuttle in December 2023, Darwin will explore how to control the buses remotely
- For now, a safety operator is a legal requirement, but Darwin believes the shuttle bus could run without the safety driver on board when the regulations change.
- A combination of cellular and satellite connectivity could enable self-driving vehicles to be widely deployed, serving rural locations, as well as cities

Since November 2021, a self-driving shuttle bus has been ferrying passengers around the Harwell Science and Innovation Campus in Oxfordshire, in the UK. That makes it one of the longest running trials of such vehicles, which could improve road safety and reduce greenhouse gas emissions by enabling people to share more road transport.

Although UK regulations require it to have a safety operator on board, the electric shuttle bus drives itself. It employs a mixture of 4G, 5G and satellite connectivity to enable its position to be tracked precisely and to collect the live telematics data required for regulatory and insurance purposes.

The shuttle's communications technology was developed by Darwin Innovation Group with the support of the European Space Agency (ESA) and the UK Space Agency. Although the campus doesn't have public 5G coverage, the Darwin SatCom Lab at Harwell operates a private 5G network supplied by Virgin Media O2. This enables Darwin to test its software's ability to switch

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smoothly between private and public networks, a feature that will be important for connectivity across industrial areas, ports, airports and other enterprise facilities.

Darwin is using satellite connectivity provided by Hispasat as a fall back in case 5G or 4G coverage isn't available or goes down temporarily. Darwin's technology switches seamlessly between 5G, satellites and 4G, based on availability, to ensure that so-called connected autonomous vehicles (CAVs) are always actually connected.

Lengthy trial generates new insights

"In order to reliably inform regulators and insurers about every aspect of CAVs, we need long-running services," says Daniela Petrovic, Co-Founder of Darwin. "Previous CAV trials were of short duration and provided a limited amount of information. Having run the service for two years now, we believe that we operate the most significant CAV service in the UK in terms of information and knowledge created." The data collected by the shuttle service has, for example, enabled the creation of the first smart insurance product aimed at autonomous vehicles.

One of the reasons ESA is supporting the project is to help explore how communications networks in space can be integrated with terrestrial networks. "ESA is excited to champion the Harwell shuttle service, a project that will both showcase the reliable, instant 5G connectivity delivered by converged space and ground telecommunications networks and bring low-emissions, autonomous vehicles to the roads," says Antonio Franchi, Head of 5G/6G NTN Programme Office-European Space Agency-ESA.

Created by autonomous transport specialist Gaussin Macnica Mobility and insured by Aviva, the connected autonomous vehicle (CAV) is also fitted with lidar sensors, cameras and ultrasound sensors to map the environment around it and detect obstacles, as well as a navigation antenna to help with positioning.

Travelling at a top speed of 18 km/h, the shuttle alternates between two 2 km routes on normal public roads with various roundabouts, zebra crossings, junctions and other traffic. Both routes begin at ESA's European Centre for Space Applications and Telecommunications (ECSAT). The service operates for six hours every working day, from 9am to 3pm,

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Antonio Franchi - Head of 5G/6G NTN Programme Office-European Space Agency-ESA

enabling Darwin to capture an enormous amount of data from the shuttle, which is stored in the Darwin Data Acquisition Platform. The shuttle is charged overnight between its six-hour shifts.

A warm reception from passengers

By November 2023, the shuttle had travelled over 7,700 miles autonomously and had served over 1,400 passengers. Their response has been very positive,

according to Paul Proteasa, one of Darwin's technical experts. "Many passengers have been very excited and curious to ride and learn more about the shuttle," he adds. "A ride on the shuttle is included in almost every high-profile visit to Harwell Campus." Darwin reports that younger passengers praise the shuttle for being an environmentally friendly, shared form of transport, while older passengers have praised it for its efficiency, reliability, calmness and smooth ride.

The success of the trial, which is co-funded by the UK government, industry and academia, has given Darwin the confidence to explore ways to enhance and expand the shuttle service. "We have tested remote control of the shuttle (without a safety driver present onboard) and a 12-hour service with two shuttles taking shifts, with a view to permanently establishing a second shuttle and longer service hours," explains Daniela Petrovic. For now, the safety operator is a legal requirement, but Darwin believes the shuttle bus could run without the safety driver on board when the regulations change.
Although it can't operate in extreme weather conditions, such as hailstones, heavy snow and freezing fog, the shuttle has proven to be very reliable. "The shuttle has the same maintenance needs as any other electric vehicle, which is generally less than traditional vehicles, as electric engines require very little maintenance," notes Paul Proteasa. "The shuttle has occasionally been taken briefly out of service to receive important software updates. Other than this the vehicle has been running daily."

Enhancing and expanding the service concept

In December 2023 Darwin brought a second self-driving shuttle to Harwell Campus, testing tandem work and longer service hours.

Darwin is also planning further testing of remote operation, cyber-security and operation in ports and airports. "5G technology keeps on improving and the advanced releases will have stronger safety features enabling an enhanced cyber-security shield, something that we keep testing in CAVs," adds Daniela Petrovic. "Safety, reliability and security will be the main drivers to make CAVs a mainstream transportation option."

Darwin ultimately plans to supply its connectivity technology to a broad range of vehicle manufacturers, giving them the ability to switch seamlessly between terrestrial and satellite networks. It envisions that, if one network is no longer available, another can step in with no loss of connection. This fall back solution will enable self-driving vehicles to remain connected to the internet at all times, even when travelling in rural areas with patchy cellular coverage.

Darwin envisions that on-demand shuttle services could offer public transport in places where regular bus services are economically impractical. The shuttle could receive real-time requests from passengers going to a particular destination and alter its route to pick people up.

With continuous connectivity onboard the buses, customers could track the location of available vehicles, even if they are travelling through an area without mobile coverage. Continuous connectivity could also be used to provide entertainment to shuttle bus passengers, enabling them to stream video or play online games.

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Daniela Petrovic - Co-Founder of Darwin

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Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. This enables the mobile industry's mission: to connect everyone and everything to a better future.

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About Darwin Innovation Group

Darwin Innovation Group was founded with the vision of widespread, reliable connectivity. Its technology uses terrestrial and satellite communications to complement each other, switching seamlessly between networks based on availability. This allows vehicles to remain connected on the move: an important quality for self-driving vehicles.

Darwin operates the longest-running autonomous public transport service in the UK, the Darwin Autonomous Shuttle in Oxfordshire, and aids other organisations in setting up and running their own autonomous transportation services.

To learn more, visit darwincav.com

About ESA

The European Space Agency (ESA) is an intergovernmental organization dedicated to the exploration of space. With a mission to harness space science for the benefit of Earth, ESA plays a pivotal role in advancing technology and connectivity solutions.

https://www.esa.int/

About Space for 5G/6G

Establishing seamless ubiquitous and resilient connectivity is vital in the context of emerging technologies.

5G boosts connectivity, generates business and brings added value to consumers and citizens.

ESA's flagship 5G/6G Hub was developed in collaboration with industry at the ECSAT facility in Harwell, UK.

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