# FACILITIES

# SMLL AUTOMATED VEHICLES

There are two Autonomous Vehicles available for hire at the SMLL.  Both are converted Nissan eNV200 vehicles using the open source Autoware software platform.

The system has been designed to allow clients access to all data outputs the vehicle offers offering a powerful system for autonomous driving testing and advanced data collection.  The vehicles are modular allowing clients own sensors to be integrated within the system to allow testing and validation of individual sensors  using the platform.

An array of sensors and compute power are included on the vehicle, these features are described in more detail below.

## Overview

| Vehicle Platform – | 7 seater, large cargo space |
|---|---|
| Nissan E-NV200 | 40kWh battery, fast charging, V2G capable |
| Drive-By-Wire System – STREETDRONE | Hardware integration and initial ADS implementation provided by StreetDrone |
| Automated Driving System – Autoware | Established Open-Source Platform |
| | Validated on-road automated driving (limited ODD) |
| | Manually-driven data gathering |
| Key Hardware | Computation & Data Storage |
| | GNSS / IMU Positioning |
| | V2X, Wifi & Mobile Comms |
| | Stereo & Mono Cameras |
| | LiDAR |
| | RADAR |

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### Vehicle Sensor Coverage



| | |
|---|---|
| Front RADAR (short range) | |
| Front RADAR (long range) | |
| Corner RADAR | |
| LiDAR | |
| Cameras | |
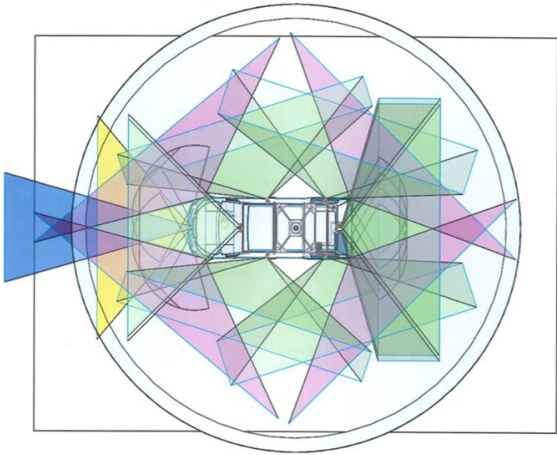
### Data Output Examples

| Output type | Description |
|---|---|
| **CANBus file** | Data events as .csv<br>Raw canbus as .stf |
| **ROSBAG file** | .bag<br>NB - Rosbag is the Robotic operating system output file which is to be loaded using the Autoware platform. |
| **Forward and side cameras output videos** | .mpg4<br>NB – the video resolution will need to be adjusted according to the GDPR Policy in place by the client |
| **LiDAR point cloud data** | Map file as .pcd |
| **Video of Autoware output** | Includes outputs from the LiDAR, radar, cameras |
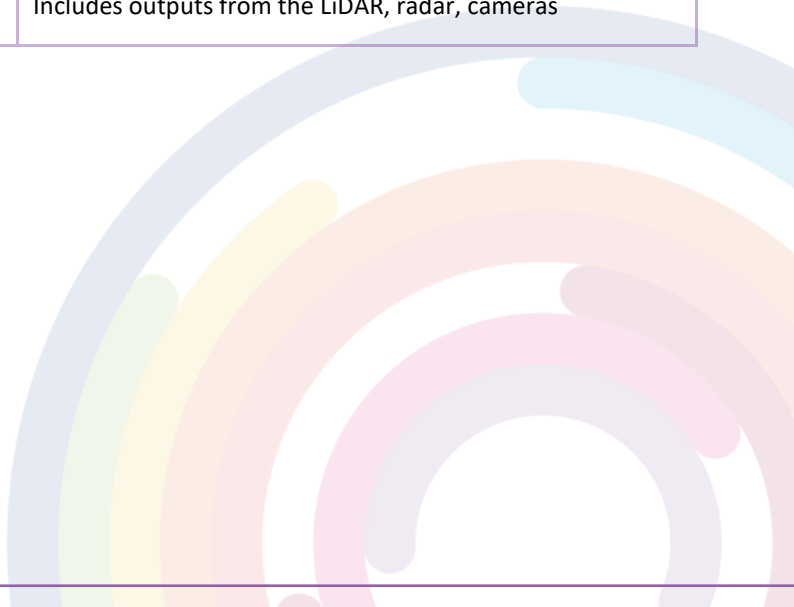
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## Hardware Specification

| Category | Item | Description |
|---|---|---|
| Platform | Vehicle Platform | Nissan E-NV200 |
| | L2 DBW Kit with Installation | Control of steering, brake, throttle and ancillaries |
| | DBW ROS Interface | |
| Computation | Compute Hardware, Storage, Installation | NEOUSYS Nuvo-6108GC |
| Sensors | Universal Roof Rack System (A) | Flexible Sensor Mounting |
| | Velodyne VLP32 | LiDAR sensor |
| | Stereo Camera Bumblebee | Bumblebee XB3 Stereo Camera |
| | Mono Camera Basler x 6 | Basler monocular camera acA1920-155uc |
| | Smart Micro RADAR (1 x T132 and 4 x T146) | SmartMicro RADAR system |
| | GPS / IMU (OxTS) | OXTS RT3002Gv2 Series |
| | Neobotix Ultrasonics with 8 x Bosch Parkpilot | Ultrasonic sensor |
| Comms and Power | CAN Logger | GEMs CAN Logger |
| | Power Distribution Module (GEMs) | GEMs power management system |
| | Multiplexer | Multiplexer for CANbus access |
| | Teltonika RUT955 Router | Wifi/Cellular Router |
| Optional | Cohda MK5 On-board Unit | V2X DSRC Radio |
| | Cisco IR829 Router | |

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### Data Variable List

**ADS**

System status [engaged/disengaged/stealth]

**Autoware**

Output from the Decision Making module

Output from the Localisation module

Output from Detection module

Output from the Vehicle Interface

**DBW Instructions**

Steering angle demand

Torque demand

**GEMS Power Management**

System status

12V power draw

**GNSS/IMU**

Acceleration (N, E, Altitude)

Velocity (N, E, Altitude)

Position (N, E, Altitude)

Angular Acceleration (Heading, Pitch, Roll)

Angular Velocity (Heading, Pitch, Roll)

Angle (Heading, Pitch, Roll)

Time of day

**Primary Sensors**

Camera video (stereo x 1, mono x 6)

LiDAR Pointcloud

RADAR Pointclouds (x 5)

Ultrasonics proximity (x 8)

**Secondary Sensors**

Brake light illumination

Brake pressure

Footbrake position

Headlight illumination

Horn

Indicator illumination

Steering angle

Throttle position

**Vehicle CANbuses**

Battery State of Charge

Door switches

Gear selector position

Vehicle speed

Wheel speed