

Virtual Seminar Series



Presented by Mr. Chris Polmear
Principal Engineer
Millbrook Proving Ground

Session #3: Vehicle Testing & Simulation

Connected Vehicle Testing with 5G Technology

▲ Abstract

The presentation explains how 5G technology is used for connected vehicle testing at Millbrook Proving Ground. It gives an overview of the onsite networks available, and an explanation of our approach to connectivity, vehicle data, and data processing. It includes examples of real-world use cases involving data acquisition from test vehicles.

▲ About the presenter, Mr Chris Polmear

Chris Polmear is a Principal Engineer in the Vehicle Group at Millbrook Proving Ground. He develops test procedures and methodologies for new legislation or requirements, and runs continuous improvement activities to update existing procedures utilising new technologies and methodologies. Recent projects have had a particular focus on integrating connectivity and streamlined data processing.



Connected Vehicle Testing with 5G Technology

Real world connectivity @ Millbrook Proving Ground

Prenscia Virtual Tech Day: 10th November 2020



www.millbrook.co.uk

Millbrook Group - Overview



We have test facilities in:

- Finland;
- The UK; and
- The USA

and sales offices in:

- China; and
- Germany



Background



5G allows test vehicles to have a permanent, fast, low latency, data connection to either a central hub (e.g. a test engineer monitoring multiple tests) or to other vehicles.

The buzz-words

- 5G
- Internet of Things (IoT)
- Big Data
- Smart Grid
- CAV

Meanwhile, in the real world...

- Test vehicles collecting data
- Remote access
- Synchronisation of vehicle data

Data data data

- Vehicles have more and more sensors
- “slow” data – CANBUS
- “fast” data – FlexRay
- “really fast” data – Ethernet
- Additional sensors
- Data used by development engineers



Millbrook's Approach



On site 4G/5G private networks.

80211.p V2X network.

mmWave V2X network.

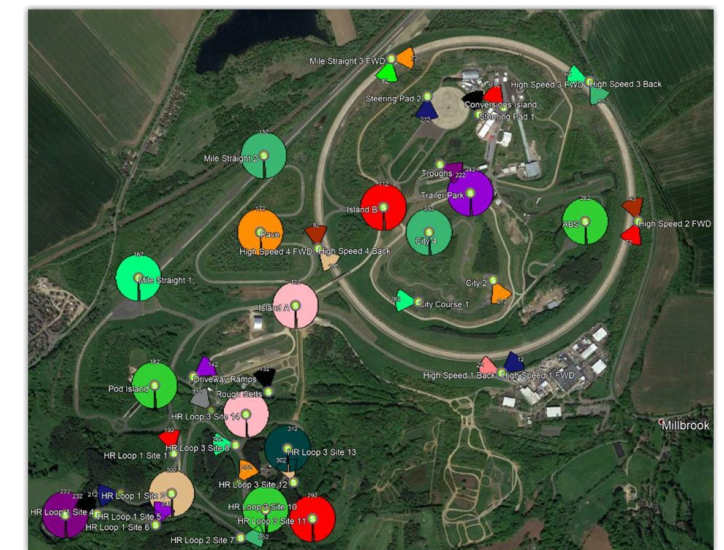
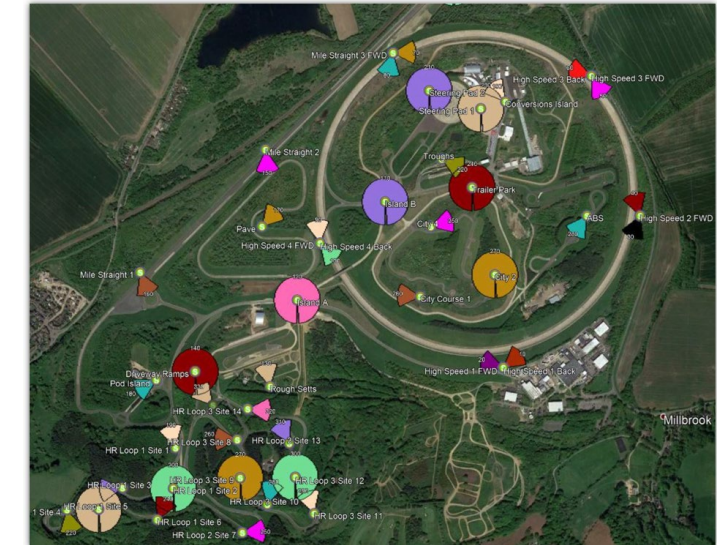
Custom solutions based on proven technologies.

Connectivity

- 19km fibre
- 59 masts
- Covers 70km of tracks
- 80211.p – 5.9 Ghz V2X WiFi
- 2.3 GHz Band 40 LTE
- 3.7 GHz Band 48 LTE
- mmWave – 60 GHz V2X

Integration

- Use of proven technologies - KISS
- PC based data acquisition
- 4G / 5G Hotspots (Ethernet / Wifi)
- VPNs / SSL Tunnels
- Flexible data acquisition software
- FTP data transfer
- Remote desktop services



Vehicle Data



Millbrook uses flexible data acquisition systems in order to integrate almost any sensor type into one time synchronous measurement system.

Vehicle Networks

- LIN
- CAN
- CAN FD
- FlexRay
- Ethernet

Additional Sensors

- Accelerometers
- Thermocouples
- Strain gauges
- GPS (including RTK correction)
- Almost any sensor type

What to record?

- Vehicle networks – “free” data
- Considered sampling rates
- Keeping data file sizes sensible
- Triggered recording
- Long term/short term logging



Data Processing

A data management system is essential to ensure the best value is obtained from all recorded data.

What to do with all the data

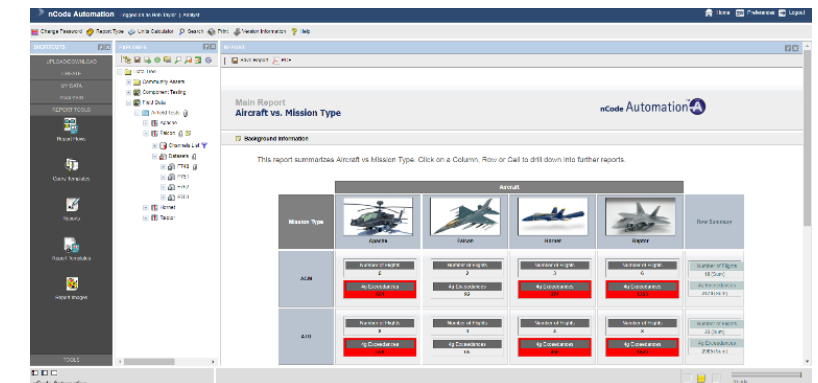
- Transfer – VPN / FTP
- Storage – Servers / databases
- Processing / analysis
- Report
- Feedback

Our data management solution

- Automated file upload
- Raw data database
- Automated data processing
- Automated reporting
- Long term statistical analysis



nCode AutomationTM 



Example 1 – Long Term Vehicle Durability Data Logging

Data logging of Vehicle Durability test fleet, ranging from full vehicle durability to component specific tests across all types of vehicle

Vehicles

- Motorcycle, HGV, bus, passenger car, lawnmower
- Range of propulsion technologies

Test Cycles

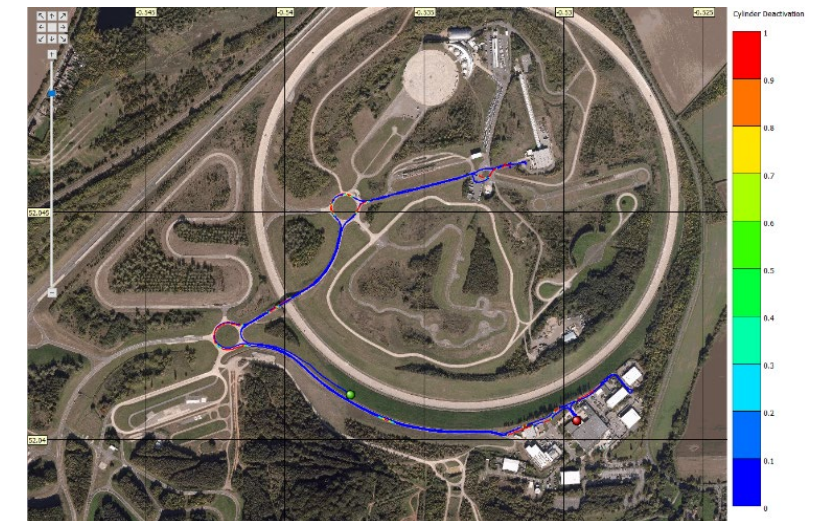
- Public road simulation
- Whole vehicle durability
- Dedicated component tests
- Up to ~80,000 miles / 12 months

Data / Loggers

- Vehicle CAN + GPS
- Advanced / custom PIDs
- Constant data streaming at 1Hz
- Dedicated data logger hardware
- Remote config. and management
- Connection over on site cellular network
- Automated logger start/stop without driver interaction
- Live display and trigger for driver

Data Processing

- Daily data exports
- Automated processing of daily summary
- Automated processing of weekly summary showing overall statistical trends



Example 2 – Short Term Data Acquisition

Short terms tests running more data channels at higher sample rates.

Test Cycles

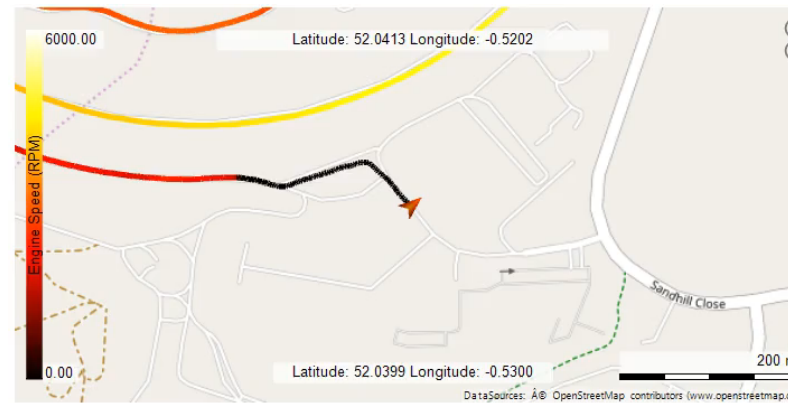
- Short term tests
- Specific events / manoeuvres

Data / Loggers

- Vehicle networks
- Analogue sensors
- Up to hundreds of channels
- Up to 1 MHz sample rates
- PC based data acquisition
- Connection via RDP
- Engineer has full control from their desk

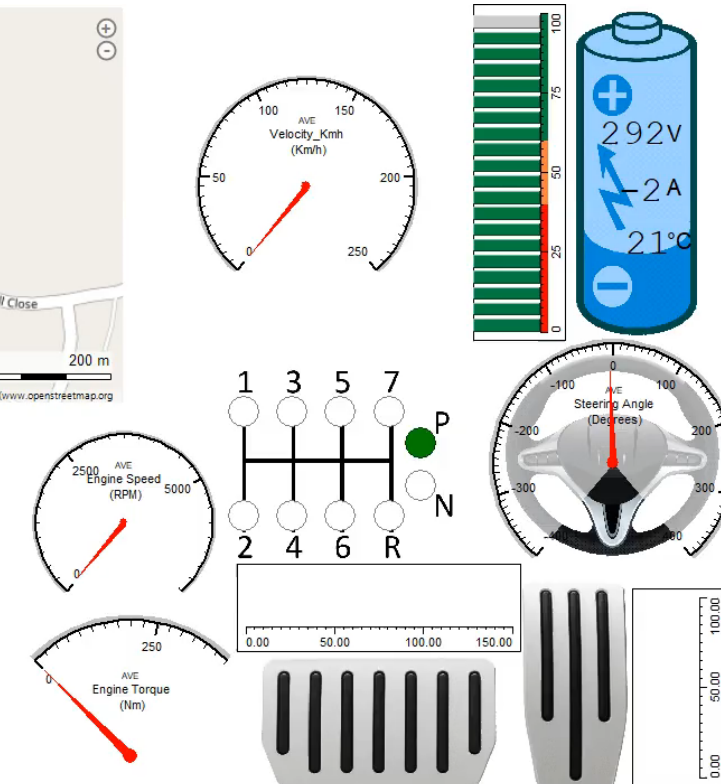
Vehicles

- Anything from motorcycle to bus, truck and military



Data Processing

- Data exported automatically on completion of test
- Raw and exported data automatically uploaded to Millbrook FTP server



Example 3 – ADAS Testing

Real time synchronisation of multiple vehicles using 5G network.

Typical Tests

- Autonomous Emergency Braking (AEB)
- Adaptive Cruise Control (ACC)
- Automatically Commanded Steering Functions (ACSF)
- Autonomous vehicle interaction

Typical solution – Point to point WiFi

- Limited range
- Limited bandwidth
- Line of sight
- >2 vehicles can be a problem

Millbrook's Solution

- Multiple vehicles around site
- Fixed RTK base station covering entire Proving Ground
- Every vehicle has connectivity via 5G network
- Virtual network hosted locally allows all vehicles to “see” each other
- All data shared in real time between vehicles
- Time synchronised via GPS



Example 4 – Remotely Witnessed Testing

Real time witnessing of tests by customers and type approval authorities using 5G network.

Typical Tests

- Pass by noise (ECE R51)
- Brakes (ECE R13/13h)
- Steering (ECE R79)
- Tilt test (ECE R107)
- Customer specific procedures

In the “olden days”

- On site attendance from customer
- On site attendance from type approval authority
- Travel time and expense

Millbrook’s Solution

- Vehicle connectivity on track provided by private on-site network
- Screen sharing and communication via Skype / Teams / WebEx
- Mobile camera for detailed parts inspection and analysis
- CCTV covering most tracks and facilities
- No travel required
- More tests can be witnessed in one day
- COVID-secure



Challenges / The Future

Systems built up and integrated by Millbrook engineers.

Challenges

- Lack of “turnkey” solutions
- Integration
- Video!

The Future

- More data
- More vehicles
- Faster data
- CAE / virtual design and development
- Less physical attendance on site



4K
ULTRA HD



Any Questions?

Chris Polmear CEng IMechE

chris.polmear@millbrook.co.uk

Principal Engineer – Vehicle Group

Millbrook Proving Ground

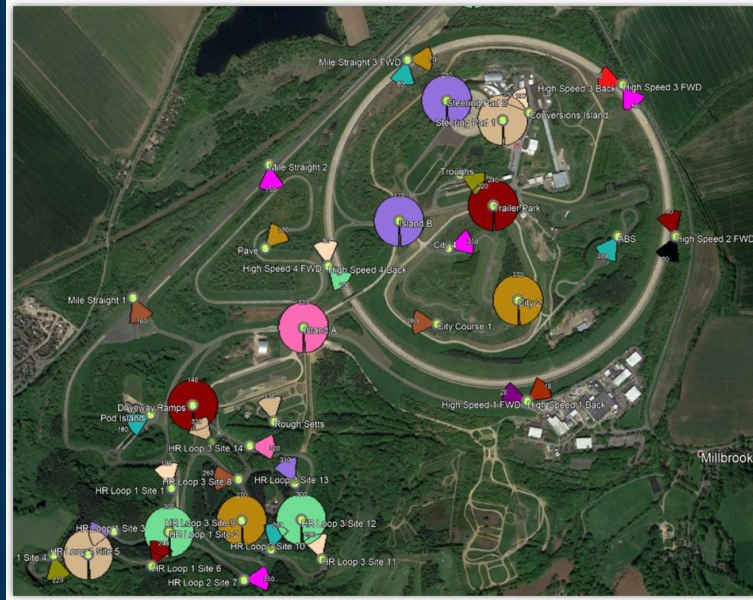


www.millbrook.co.uk

Q&A

▲ (no questions)

Virtual Seminar Series



Connected Vehicle Testing with 5G Technology

Presented by Mr. Chris Polmear
Principal Engineer
Millbrook Proving Ground

Session #3: Vehicle Testing & Simulation