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## **GATEway project** **Advisory group meeting – March 2016**

Presented by Prof. Nick Reed  
TRL

March 2016

**GATEway**



# Agenda

- 10:00-10:10 Welcome/terms of reference/rules of the day
- 10:10-10:30 Introductions
- 10:30-10:45 Activity since AG1
- 10:45-11:30 Introduction to new vehicle providers
- 11:30-11:45 Insurance, risk management and liability update
- 11:45-12:00 Stakeholder engagement update
- 12:00-13:00 Lunch

# Agenda

- 13:00-13:30 Feedback and discussion
- 13:30-13:40 Synthetic environment and teleoperation
- 13:40-14:00 Real world trials
- 14:00-14:15 Evaluation, exploitation, dissemination
- 14:15-14:30 Working groups
- 14:30-15:00 Closing discussion, AOB
- 15:00 Close

# Terms of reference/rules of the day

- Share progress on GATEway project
- Receive feedback and ideas on project plans
- (and eventually on deliverables!)
  
- Record attendance (unless you say otherwise)
- Minutes are being taken, comments not attributed
  
- PM



# Innovate UK competition: Introducing Driverless Cars to UK Roads

- Launched Feb 2014
- £10m competition funding up to three projects



Department  
for Transport



Department  
for Business  
Innovation & Skills



**Innovate UK**  
Technology Strategy Board

- Automated vehicles in urban environments
- Must include cars and one other form of transport
- Proposals must be **business-led** and collaborative
- **Not** about technology

# GATEway (Greenwich)



Greater London



Royal Borough of Greenwich

Houses of Parliament

Tower Bridge

London Heathrow airport



Royal Borough of Greenwich





# Greenwich, London – A compelling venue



# GATEway consortium

Experienced  
project lead



Smart city  
Location and  
local authority  
partner



Large multi-  
national  
organisations



*Telefonica*

O<sub>2</sub>

World leading  
research  
organisations



UNIVERSITY  
of  
GREENWICH

Imperial College  
London

Targeted,  
capable  
SMEs



PHOENIX WINGS  
SMART MOBILITY CONSULTANT



COMMONPLACE

**GOBOTIX**  
LTD



# GATEway consortium

Experienced  
project lead



Smart city  
Location and  
local authority  
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Large multi-  
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O<sub>2</sub>

Heathrow

World leading  
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COMMONPLACE

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OXBOTICA



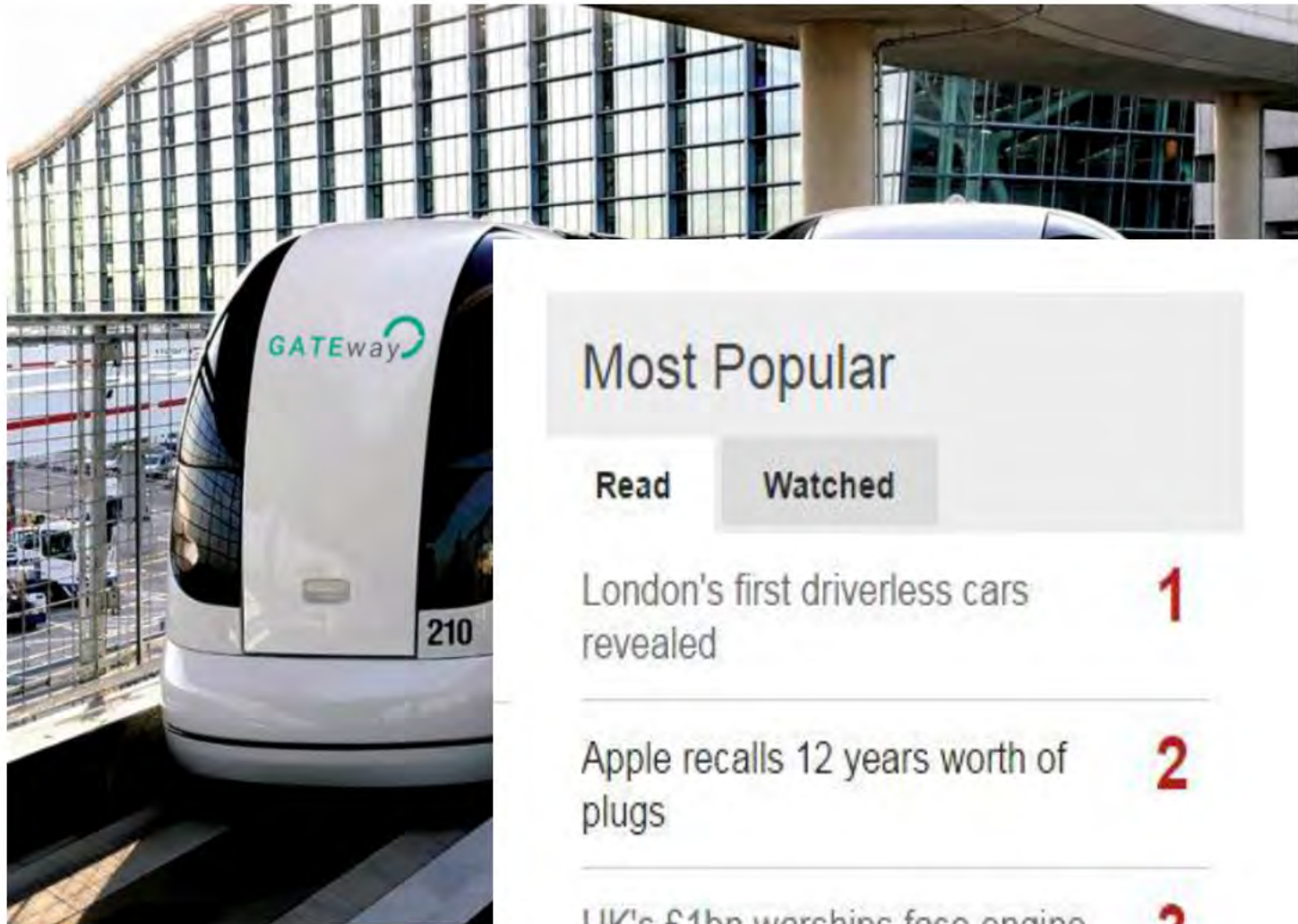


# Shuttle vehicles for GATEway





# Shuttle vehicles for GATEway



# Shuttle vehicles for GATEway





# Trial 1: Fully automated shuttle transport

- Route on Greenwich peninsula (TBC)
- Participants invited to experience the shuttle in a managed process
- Different demographic groups invited to participate
- 'Steward' on board
- Seek other use cases





# Trial 2: Autonomous valet parking

## ■ Part 1:

- Participant drives to drop-off point
- Gets out, sets vehicle off to park using smartphone interface
- Vehicle fully autonomously finds parking space



## ■ Part 2

- Participant uses smartphone to summon vehicle to collection point
- Resumes normal driving

## ■ Investigate:

- User attitudes: Trust, acceptance, willingness to pay
- Accuracy of parking: Benefit to parking density

## Trial 3: Urban deliveries

- Automated van deliveries
- Support urban supply chain through use of:
  - Zero emission
  - Low noise
  - Automated vehicle
- Demonstration of use case



# DigiCar – trial to test behaviour with automation



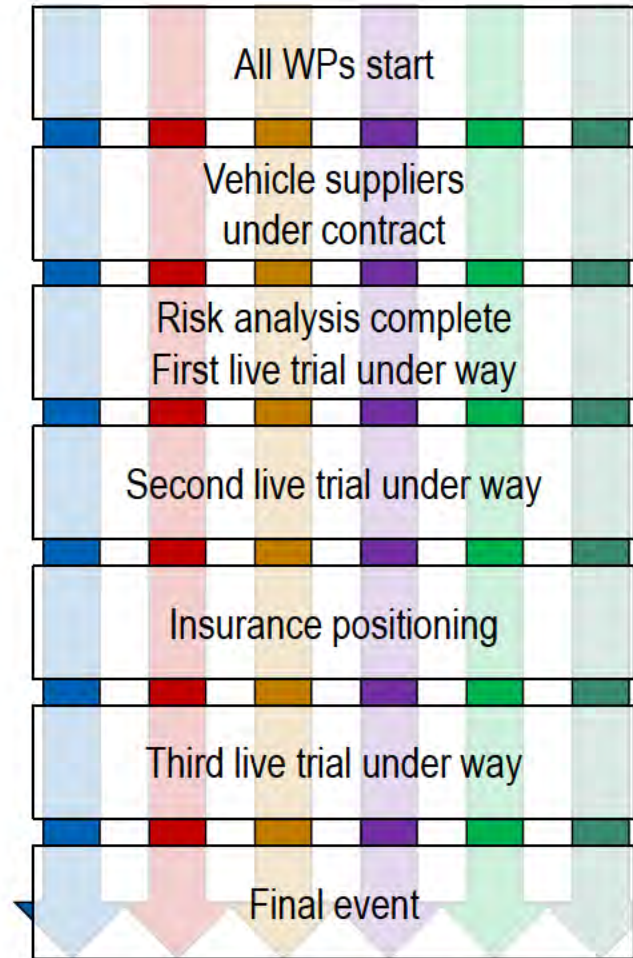


# Teleoperation



# Work programme – technology delivery at pace

WP 1 2 3 4 5 6



- Two year project
- Oct 2015-Sep 2017
- All WPs to commence from Month 1
- First task to procure vehicle suppliers
- Ensures early delivery of automated vehicle capability and results

**GATEway continues as an active automated vehicle test environment**



# TRL CAV activities

- MOVE\_UK (~£5m R&D)
  - Bosch
  - TRL, JLR, Direct Line, The Floow, RBG
- ATLAS (£175k Feasibility)
  - Ordnance Survey
  - TRL, Sony, Oxford Technical Solutions, GOBOTiX, RBG





# UK Smart Mobility Living Lab

- Open innovation environment
- Smart mobility testing, development and validation
- Collaboration between TRL and RBG
- Safe testing in a complex real world environment



UK Smart Mobility  
**Living Lab**  
@ Greenwich



# Introduction to new vehicle providers

- Presentation from Westfield and Oxbotica





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## GATEway Trial 1

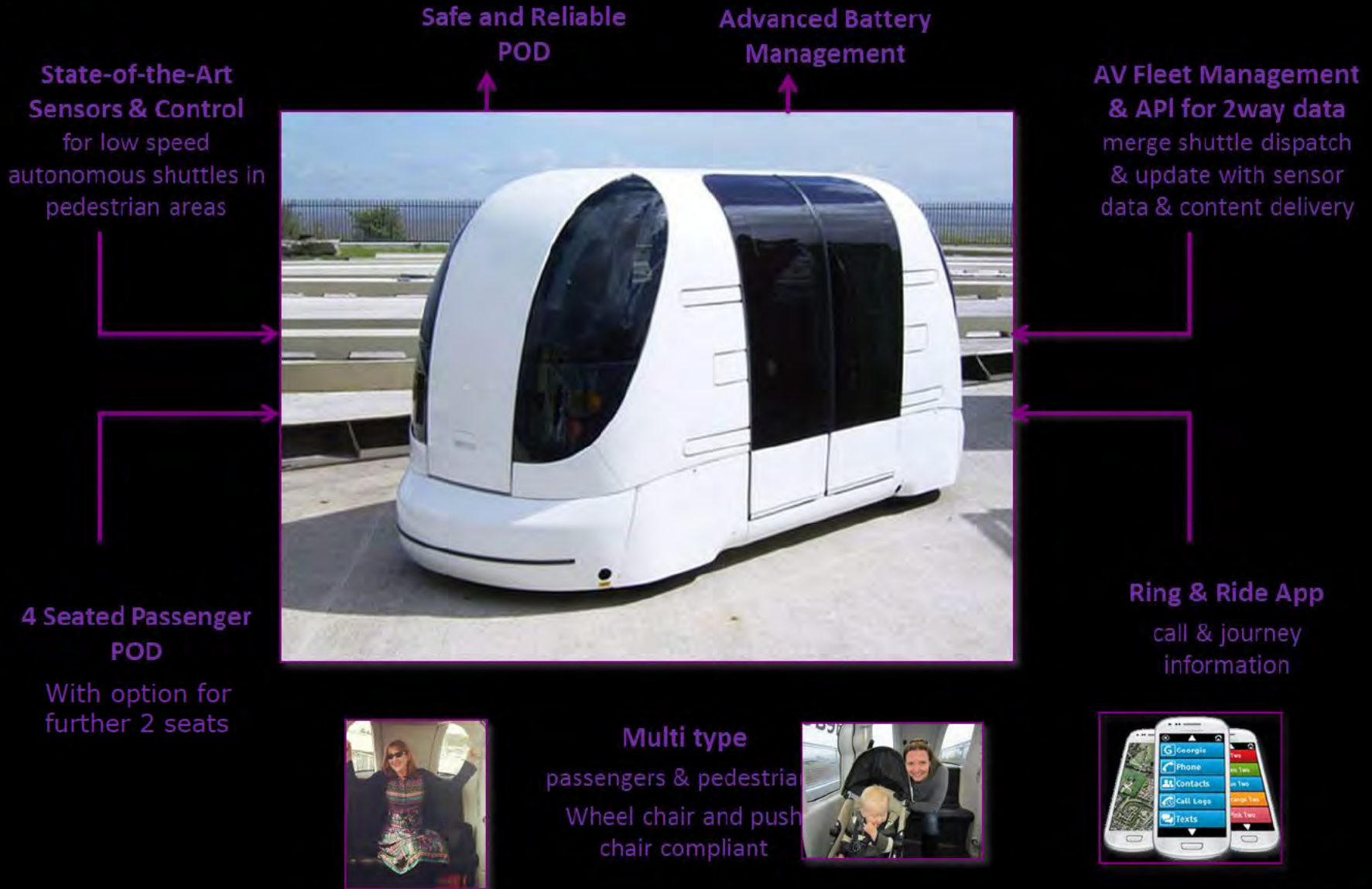
Presented by Julian Turner  
Westfield Sportscars Limited

4<sup>th</sup> March 2016

GATEway



# Project Overview





# Vehicle Overview



# Vehicle Overview



## Energy efficiency

The system has an average energy usage of only 0.55 MJ per passenger km, typically providing at least a 50% benefit over buses and trains, and a 70% savings in emissions over cars.

## Noise

Measurements taken during a series of vehicle drive-by tests found that at a distance of 10 meters, a pod running at 14mph produced noise levels of around 35 decibels – less than the background noise expected in a library.





# Vehicle Overview

## Physical Specifications

Vehicle length	3.7 m
Vehicle width	1.47 m
Vehicle height	1.8 m
Empty weight	850 kg
Door opening area	≥1.5m x 0.9m (h x w)
Flat floor area	≥1.44m x 1.2m (l x w)

## Performance & Manoeuvrability

The table below gives a summary of the performance statistics for the Ultra pods:

Maximum speed	40 kph (25 mph)
Emergency deceleration rate	~ 3 m/s <sup>2</sup>
Vehicle range	> 10 km
Maximum payload	450 kg
Minimum turn radius	5 m
Maximum climb angle	20 %
Maximum planned climb angle	10 %
Maximum planned decline angle	6.25 %

## Powertrain and energy systems

- '7kW' synchronous AC drive motor (typical average motive power use < 2kW)
- Solid state drive controller/inverter
- 4 x 45Ah rear mounted 48V-nominal starved electrolyte lead acid traction batteries
- Automatic charging points
- Fixed ratio transaxle assembly
- Front wheel drive.

**\* Batteries changed to Lithium Ion Phosphate**

## Braking Systems

- Drive motor regenerative braking
- Fail safe electromagnetic 'hold off' motor brake
- Fail safe electromagnetic 'hold off' rear wheel brakes
- Safety interlocks between brakes, motor and doors.

# Consortium



Westfield designs, manufactures, and tests a range of specialist vehicles for global niche markets. In addition to manufacturing in the Midlands, most types of vehicle use 100% British components. Westfield have designed and built the worlds first one make pure electric race car and have manufactured and registered Hydrogen Fuel Cell, Pure Electric and hybrid vehicles. Westfield have European Small Series Type Approval for both premises and products which allows the company to sell products globally. Westfield have 24 Dealers across the globe and have worked with the certification authorities in most countries to register their cars. Westfield will be the vehicle integrator and manufacturer of the PODs.

Heathrow operates the UK's busiest airport. The Heathrow Pods are driverless electric 4 seat shuttles providing a transfer service between car parks & terminals. Since 2011, the 21 Pods have carried 1.5M passengers and completed over 3Million autonomous kilometers. Heathrow will be providing the software support for the project.

**Heathrow**  
Making every journey better

**OXBOTICA**

Oxbotica provide the Autonomous Control System in the LUTZ pathfinder pods and in the 40 autonomous pods that form the backbone of the UK Autodrive project and are flexing the same platform for use in cars, warehousing and other vehicular applications. Oxbotica will be providing support to integrate the sensors to the POD and provide support for the fleet management.





# Consortium Experience



34 Year old British Company manufacturing Lightweight vehicles  
Formula E Battery Management System Technology  
Petrol, EV, Hybrid and Hydrogen Fuel Cell Vehicle integration experience  
European Small Series Type Approval Compliance for quality systems and exploitation  
Links with global Vehicle Certification Agencies for bespoke products  
Aerospace, Rail and Automotive experience in Safety Cases  
Developed Agile British Supply Chain Solution – delivering 100% British Product\*  
Project Manager – ex Boeing, Airbus UK, Bombardier, Trains, Mott MacDonald – (Astute Safety Case, CVF ARM, Highways Area 2,4,12, FiReLink Comms)  
Project Director is President of IFAW, Ex RR Main Board, Ex Lucas Main Board, Ex British Midland Main Board, Ex Chairman of Mettis, SRTechnics – Brings Vast safety case experience



20 Strong Delivery Team have worked on the POD since conception 1995  
2001 – Test Track Developed to test several PODs  
2011 – System entered full operational Status at Heathrow Airport  
Existing Safety Case  
Existing Vehicle and passenger data  
Heathrow fully support the Business Case for the Project and have offered to provide facilities, infrastructure, resource and management expertise to make the project a complete success – Main Board Approval and support





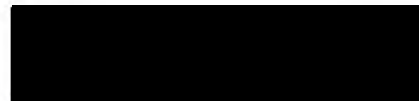
# Project Plan

- To date
  - Conducted selective PR
  - Wind Tunnel Test
  - BOM definition
  - Supplier Audit
  - Mapping
  - Route Selection
- Final Specification of vehicle options 11<sup>th</sup> March
- Vehicle 1 – Test End of May/ Beginning of June – Existing Vehicle Modified
- Trials Starting with RCA July with New vehicles



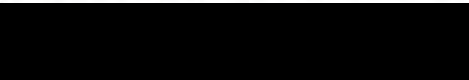


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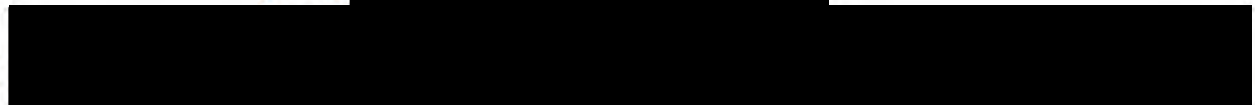


Chief Executive Officer  
Westfield Sportscars Ltd

Tel:



Email:



# Vehicle Info

## Exterior body, doors and glazing

- Body panels constructed in self-coloured ABS with high gloss acrylic capping
- Vacuum-formed exterior panels bonded to vehicle structure
- Twin leaf plug and slide doors
- Doors actuated by DC motors through reduction gearbox and locking linkage system
- Microprocessor controlled door operation
- Door leaves constructed of ABS panel, steel reinforcement and bonded laminated glass
- Flashing door header rail warning
- Vacuum-formed tinted acrylic 'quarter window' glazing
- External vehicle operating lights (front white and amber, rear red and amber)

## Chassis, suspension and steering systems

- Fabricated aluminium 'ladder frame' lower chassis with structural aluminium honeycomb floor and bulkhead panels
- Separate front and rear aluminium fabricated sub-frames with mountings for suspension, steering, motor/transmission and batteries
- Bumper structure designed to progressively absorb impact energy
- Welded steel tubular upper frame to support exterior and interior bodywork, side doors and front/rear hatches
- Double wishbone suspension front and rear using predominantly aluminium machined wishbones, coil over damper units and standard automotive joints, bearings and bushes
- Rack and pinion steering gear, operated by automotive electric power steering unit
- 13" Wheels with automotive tubeless radial (135x70R13) tyres



# Vehicle Info

## Control and guidance

- Autonomous guidance, navigation and control unit using a combination of sensors for navigation
- Condition and performance monitoring of vehicle components and systems
- Automatic Vehicle Protection System to prevent collision between vehicles on guideway
- Wireless communication system for 2-way data, passenger communication and command exchange between vehicle and system central control.

## Interior and passenger controls

- Interior panels vacuum-formed from grey, grained ABS
- Seats facing front and rear providing flexible accommodation for 4 adults
- Illuminating door/control switches
- Illuminating communication/alarm switches at both ends of vehicle (diagonal pair front right and rear left)
- Two-way communications between passengers and control team
- Internal and externally releasable emergency exit (locked while vehicle in motion)
- Passenger information LCD screen
- Internal lighting sufficient for reading
- Vehicle signs/symbols and information labels
- Non-slip, easy-clean floor covering
- Cabin heating, ventilation and air conditioning
- Cabin smoke detector, emergency fire extinguisher and two internal CCTV monitoring cameras mounted in the ceiling
- Weight sensors to monitor vehicle loading and prevent operation if overloaded.

# Insurance, risk management and liability update

- Presentation from RSA



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3

# Exploring the Implications for Insurance of Autonomous Vehicles

Presented by Kenny Leitch  
RSA Group

4<sup>th</sup> March 2016

GATEway





# Insurance and Autonomy

A reminder of why Insurance and Risk Management matters

- 1.2 million road deaths globally
- X10 more seriously injured victims
- £15 billion industry (UK)

but

- 93% of all motor accidents are impacted by human error
- ...so huge potential for reduction in collision risk
- ...and subsequent pain, death and suffering
- ...and consequent savings in insurance premiums / hidden costs

plus

- Potential to reduce operating and ownership costs by 80%
- Better use of scarce resources and reduction in congestion (On average cars are not used 95% of the time)

# Insurance, Risk Management and Liability

- Our key objectives are:
  - To understand the critical risks
  - Safety implications
  - Liability potential
  - Insurance and cyber related implications of automated vehicle operations
- Working closely with TRL and other consortium members
- Alongside this we
  - Need to understand and deal with cyber crime risk
  - Support the 'sharing' economy and emerging 'hub' nature of cities
  - Need to understand growth in new technologies - Fuel and Autonomy
  - Implications on the wider Insurance Market (autonomy is a huge disruptor across the industry)



# Motor Insurance

- 'Motor' Policies are designed by and large to be 'All Risks' policies so cover 'everything' with specific exclusions, so allow for degree of flexibility
- However sitting behind policies are detailed policy wordings that form the basis of the contract. Most, if not all, will have emerged from, or written at a time pre-dating current technological advances.
- Much has been developed through case law
- Policies need to be overhauled and updated to reflect the new operating environment and technologies:
  - Definitions, Exclusions and Conditions (e.g. keyless / driverless vehicles)
  - 3<sup>rd</sup> Party Motor Insurance is compulsory, and follows the RTA 1984 / 1988
  - RTA bases a lot of it's legislation on the driver (being 'responsible', 'in charge' plus licencing considerations, medical requirements, claims experience and convictions) together with construction and use
  - Will need to be fundamentally re-written, including dealing with responsibility and ownership of vehicles



# Insurance Considerations 2

- 'Ownership' of the insurance
  - Some suppliers have already indicated they would assume responsibility for the insurance of their own manufactured autonomous vehicles
    - Extent of cover
    - Duration (i.e. time / warranty / purchaser limited)
- Breadth of Cover
  - Nature of risk is changing – from mechanical to 'computers on wheels'
  - Cyber security and protection will increase in importance
- Underwriting and Pricing Implications
  - Reduction in frequency and severity reducing claims costs, and premiums
  - Insurers like to price based on 'big data' and looking backwards. Mind-set needs to change
  - Driver is key rating factor – this will shift fundamentally
- Potential of disruption to existing Claims Models
  - Potential for a 1<sup>st</sup> party damage model – requirement for policy holders to recover directly from their own Insurer regardless of fault
    - Ban / limit subrogation of claims costs
    - Level of minimum compulsory insurance cover / statutory accident benefit



Thank you



Global Telematics Director  
RSA Group

Tel: [Redacted]

Email: [Redacted]



# Stakeholder engagement update

- Presentation from RCA





## Work Package 3 – Public, Media and Industry Stakeholder Management

Presented by Dale Harrow  
Royal College of Art

February 2016

GATEway 

# Work Package Partners

- Commonplace
  - Public sentiment mapping and design feedback
- Royal College of Art
  - Public and stakeholder attitudes explored through co-creation workshops
- TRL
  - Public attitudes explored through qualitative interviews (pre- & post- trial)
- University of Greenwich
  - Pedestrian behaviour monitoring, evaluating and modelling

# Commonplace

- Commonplace site
  - Set-up Commonplace site for launch – potentially w/c 8<sup>th</sup> March
- Agreed screening questions for online recruitment
  - for trials/workshops/interviews..
- Agree and commence promotional plan?
- Twitter harvesting methodology?
  - Investigating best method – organic approach or purchase of data-stream or organic approach.



# TRL

- Led by Stephen Skippon (formally Shell)
- Pre- & Post- Trial Interviews
  - Draft prepared for discussion guides
  - Draft prepared for mini-questionnaires for interviews

# University of Greenwich

- Project Management
  - Staff in place
  - University of Greenwich website running since 1<sup>st</sup> week in Feb
- Shuttle trial site
  - Initiated discussions with Greenwich Park stakeholders and TRL? *Status?*
- Research development
  - background research
  - work on identifying key research questions

# Royal College of Art

- Desk Research into people's perspectives of autonomous vehicles
  - History of autonomous vehicle development (non-technical)
    - Representations in sci-fi; state of the field; future concept vehicles
  - Literature Review (part complete)
    - Human-computer interaction
    - Create taxonomy of issues
  - Media Review
    - Journalist & Public Comments, positive & negative, analysed into 20 categories
  - Expert Interviews (part complete)
    - Eric Harris, Senior Researcher, Rica
    - Iain Macbeth, Automotive & Intelligent Mobility, TFL



# Royal College of Art

- Engagement Plan
  - Synthesis of background research (in progress)
  - Recruitment – who and how
    - Developed recruitment screening questions with TRL and Commonplace.
    - To be used for any expressions of interest logged on Commonplace site.
    - Aim: shortlist of people interested in workshops/interviews (TRL lead on recruitment)
  - Research questions & actions (in progress)
  
- Engagement Plan deadline – Friday 11<sup>th</sup> March

# Team Recruited

## The Street Master



## | Research Activities to Date

R1 - Pilot Studies - Researcher role-playing to gain empathy

R2 - Passenger Shadowing - Following 'extreme' passengers on journeys and testing in prototype

R3 - Driver Interviews - In-context interviews with drivers about their personal space and journeys

R4 - Driver Workshop - Consulting drivers about driver space with co-design exercises and prototype testing

R5 - Driver-Passenger Workshop - First co-creation session with both drivers and passengers together

R6 - Driver and Passenger Surveys - Online surveys to validate key design points

R7 - Expert Reference - Regular updates and consultations with key transport experts and officials



## | Previous Research - R2 - User Testing



## Current Research - R5 - Passenger / Driver Workshop



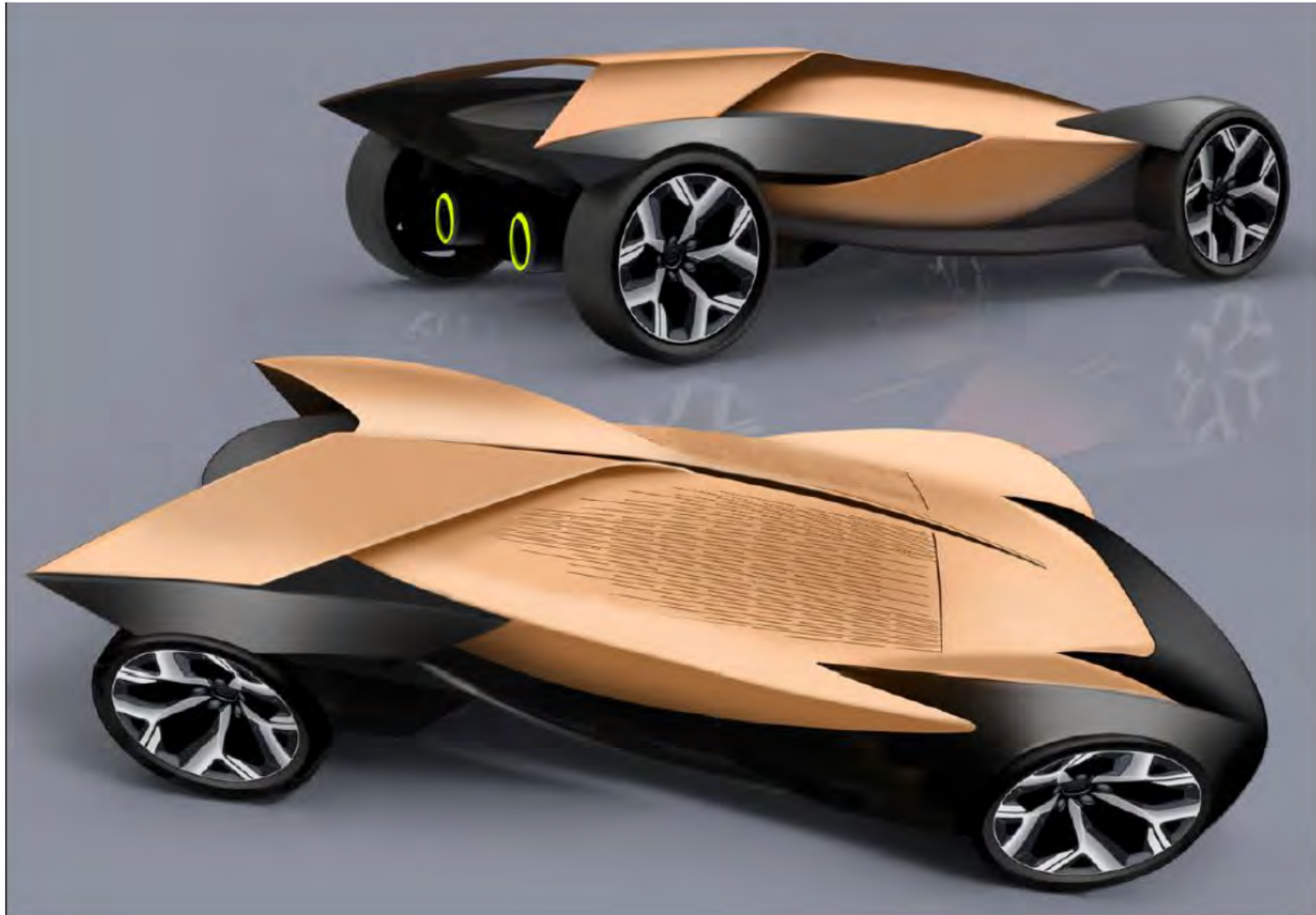
The first time drivers and passengers have been consulted together



# RCA studio projects









## the 'Cushions'

speakers  
lights  
storage  
massage pads  
screens

holding cushions  
by magnetic power  
on the surface

fingerprint  
identification

transparent  
magnetic  
material

## Spin door mechanism

## Range ability of window area



5%  
window area

More privacy  
Display of patterns



76%  
window area

Better view  
comfortable zone

**Could car be a better platform to share?** You take your own stuffs in and create your unique interior. The interior can be a comfortable part of your living room and the personal art decoration of your car on the road.



■ **Could car be a better friend than just a tool?** It's hard to believe the car is intelligent enough to drive itself, is not capable to make the user feel safer, friendly, fun, comfortable. It should be nice to drive on the autonomous car.

The robot (Muffin) is the driver

The robot (Muffin) is the driver

### ■ Customize your Inside-Out

With different colours, materials, patterns, and even functions



monochromatic



chromatic

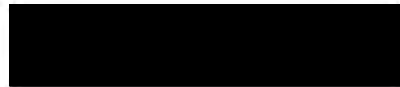


customizable systems





Thank you



PI

Royal College of Art





# Lunch

# Synthetic environment and teleoperation

- Tender process run to secure provider for 3D database of Greenwich peninsula environment



# Synthetic environment

- Draft study plan in development for simulator trials
- Research questions:
  1. Where drivers have the right of way, do drivers approach a junction differently based on whether they encounter an AV or HDV?
  2. Where drivers are required to give way, do drivers enter a junction differently based on whether they encounter an AV or HDV?
  3. Is there a difference in drivers' overtaking and following behaviour based on whether the lead vehicle is an AV or HDV?
  4. Is there a difference in drivers' merging behaviour based on whether they encounter an AV or an HDV?
  5. To what extent are these differences influenced by traffic density?
  6. To what extent are these differences influenced by the proportion of AVs in the driven environment?



# Teleoperation

- Update from Ben

# Real world trials

- Presentation from TRL

# Evaluation, exploitation, dissemination

- Presentation from TRL





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# GATEway Exploitation

Iwan Parry, GATEway Exploitation Lead  
TRL

4 March 2016

GATEway



# GATEway Exploitation

- Exploitation team meetings:
  - Agreed terms of reference
    - purpose, approach, outcomes
- Partner exploitation plans
  - update on the partner's expected exploitable knowledge
  - activities to date
  - project documentation
- Opportunities for collaboration
  - Technology agnostic
    - 'Greenwich autonomous transport environment'
    - telecoms, smart city, sentiment analysis, insurance, teleoperation, supervisory control
  - Technology specific
    - supporting the project technology
    - pod deployments, nationally and internationally
    - integration with other AV technology (teleoperation)
- Developing the offerings

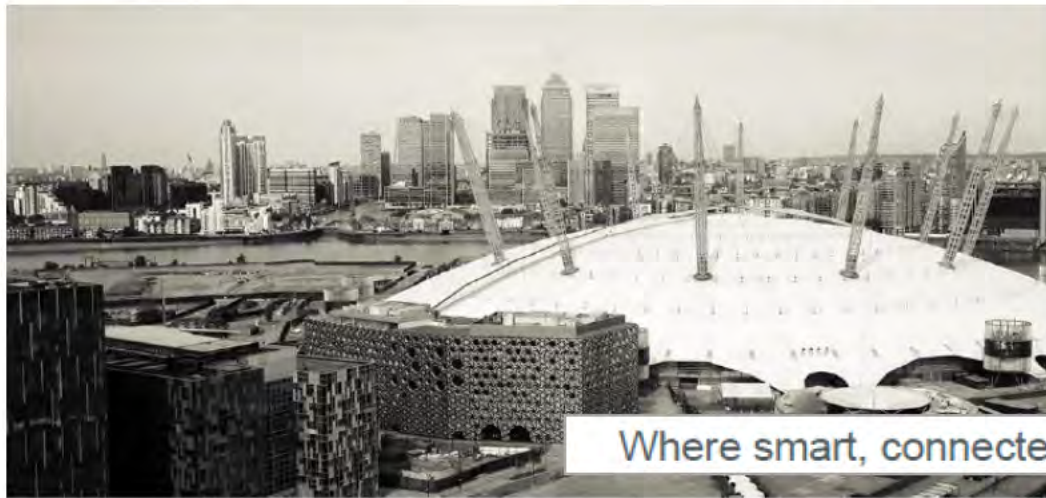


# Exploitation Opportunities – Exploitation Plan

- **Test and evaluation methodologies & benchmarking criteria** for autonomous vehicles in complex live urban environments “the UK Standard”
- **Autonomous vehicle control software development** through the specific experiences of operating in the test environment (live conditions)
- **Supervisory systems** for autonomous vehicles
- **Remote operation** of autonomous vehicle systems which require human intervention and the identification of development needs to meet test protocol criteria
- A **validated synthetic test environment (G-SAVE)** to examine interactions between drivers and autonomous vehicles in a driving simulator environment.
- An in-depth understanding of **human responses to autonomous vehicle movements** in shared environments
- An analysis of **cyber security** risks, mitigations and strategy for robust the protection of autonomous vehicle control systems



# Exploitation Opportunities – Evolving vision



Where smart, connected and autonomous vehicles come to life

# Next steps

- Expand detail and scope of opportunities
- Individual business opportunities (expand on above)
  - What, how, why
  - Partner responsibility to deliver and report progress (tracking forms)
- Consortium partnership opportunities
  - Whole consortium or sub-groups
  - Develop and communicate the vision
  - Identify and articulate additional opportunities
    - AV strategy and implementation
    - Turnkey AV PRT solutions
      - Building on a proven PRT technology platform
    - Greenwich 'Living Lab' test environment & smart city link
    - ...other



Thank you

[REDACTED]  
Exploitation Lead  
TRL

Tel: [REDACTED]  
Email: [REDACTED]





# Working groups

- Previous meeting – general agreement that three meetings over the life of two year project was insufficient
- Suggestion of working groups
  - Legal/insurance? Road safety? Technology? Location? Planning?
- ...and more frequent meetings
  - May 2016?
  - October 2016?
  - February 2017?



Thank you

[REDACTED]  
GATEway Technical Lead  
TRL

Tel: [REDACTED]  
Email: [REDACTED]

