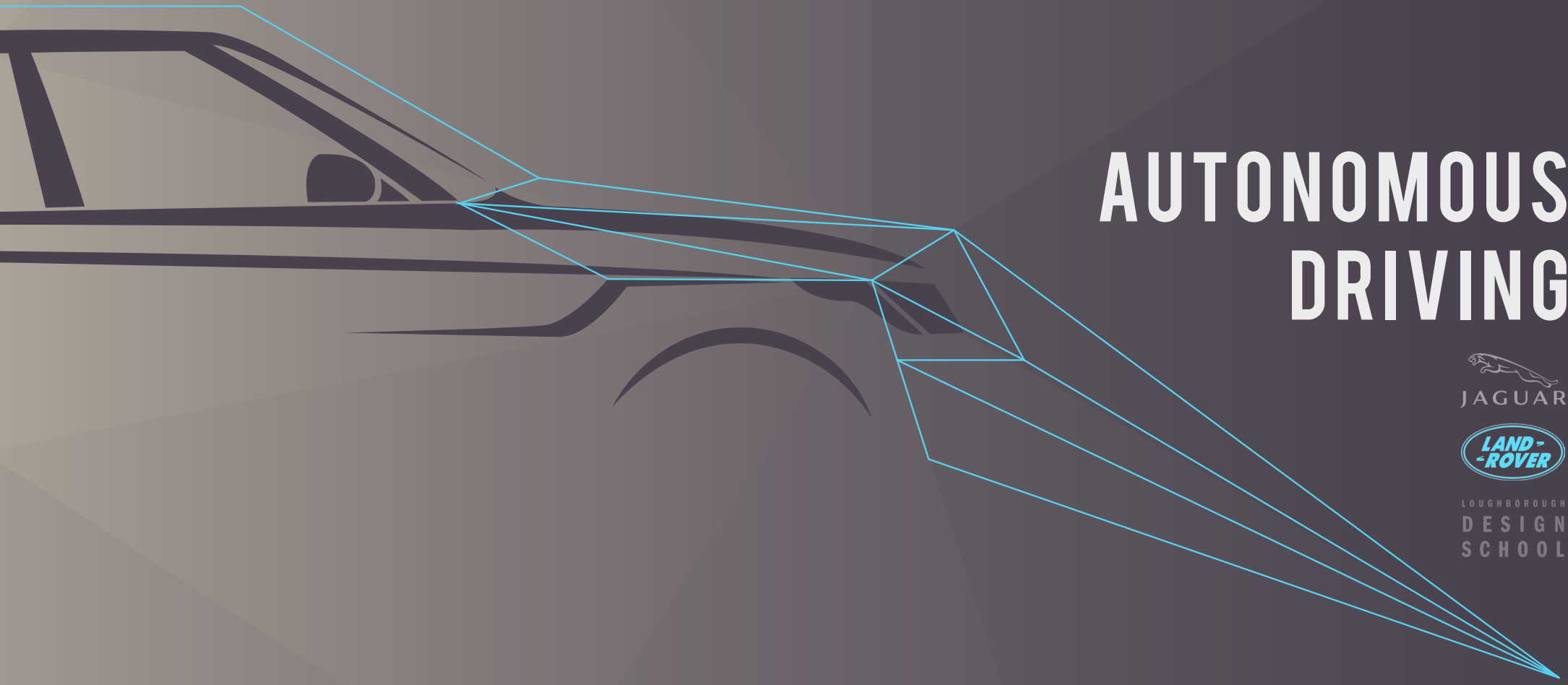

AUTONOMOUS DRIVING

JAGUAR

LAND ROVER

LOUGHBOROUGH DESIGN SCHOOL

Group 3

15DSP811 - Group Project

University of Loughborough

in colaboration with

Jaguar Land Rover

2016

Introduction

This booklet is made in conjunction with the module 15DSP811 - Group Project at Loughborough University. The aim of the module is to enable to further develop collaboration and team working skills as well as innovation and design skills through a client brief. This project was a collaboration with Jaguar Land Rover in developing a concept how to enable trust through interaction design when it comes to autonomous driving.

The Team

Yi-Ning

I am currently a master's student studying interaction design at Loughborough University. Before this, I focused on Kansei Design at National Cheng Kung University in Taiwan, this involves discussing and analysing people's emotions when using products.

Kerry

I Started out as a graphic designer and worked in industry for fours years before completing a MA in Urban Design. I worked for 6 years in London combining graphics and urban design in teams of architects and town planners. I decided to advance my skills in UX and Interaction Design, and are currently nearing the end of my Masters at Loughborough University.

Kristine

With a background in mathematics and graphic design, I am now doing a MSc Industrial Design with focus on interaction design at the Norwegian University of Technology and Science. I am currently on my fourth year and I am doing an exchange year at Loughborough University where I am studying interaction design.

Ben

Previously worked as an industrial designer for 3 years before I decided to focus on Interaction Design to further my knowledge. My goal is to be a multi-disciplinary designer where I can contribute to a wide range of projects and teams.

Miao

I studied Industrial Design in China and graduated with a Bachelor of Engineering. Now I'm studying Interaction Design at Loughborough University which not only provides me a great opportunity to exchange ideas with many people but also gives me a chance to grow with all the new challenges I face.

Jessie

During my 3rd year of undergraduate study in Industrial Design, I became interested in user experience design and the different aspects of human computer interaction. In order to further my career development UX design, I decided to study for my master's in Interaction Design at Loughborough University.

Brand Identity

Blu:Telescope

We created a brand identity to communicate our values and identity. The thought behind our brand name and identity is that we see ourselves as a design consultancy with a vision that we have no limits. The 'BLU' represents our blue-sky-thinking and 'telescope' symbolises that we have the ability to look beyond the present and into future trends and technology, allowing us to predict and adapt our designs. Collectively, we are six Interaction designers with big ideas to innovate, challenge the ordinary and make change happen.

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Background

Jaguar Landrover

“

WE CAN’T PREDICT THE FUTURE BUT WE CAN BE PREPARED

MIKE WRIGHT, EXECUTIVE DIRECTOR, JAGUAR LANDROVER

People are currently spending more time commuting in their vehicles than ever before. We can enable people to be more connected by using technological innovation to help them communicate with their vehicle and the vehicles around them and to increase their awareness of the external environment. These are all part of the personalised driving experience which autonomous cars are currently focused in.

Jaguar Land Rover (JLR) intends to be a leader and an innovator in meeting future needs responsibly. Mobility and digital technologies are key enablers, and as the world develops and grows, JLR aim to harness these to play a part as a key solutions provider for the future.

Through innovation and collaboration the automotive industry has a significant contribution to make. Future proofing technologies will help to address these challenges of environmental innovation and make a real difference in how we operate.

Introduction

Autonomous Driving

Full autonomous vehicles are something that we will expect to see as mainstream on roads by 2030. During the next five, ten and twenty years, there will significant research and development advancement into how this will look and feel. Using today's users we are able to test and understand what future users would want from their vehicles and what expectations they will have in 2030. The autonomous driving environment is currently sub-divided into five levels (L).

L0 – No automation. 100% manual driving.
L1 – Function specific automation. Functions such as assisted steering and assisted parking.
L2 – Combined function. A combination of cruise control with assisted steering - typically associated with open road/ motorway driving.
L3 – Limited self-driving automation. This is when primary control is given to the system, the user/driver takes a secondary function.
L4 – Full self-driving automation. 100% autonomous driving and 100% system control.

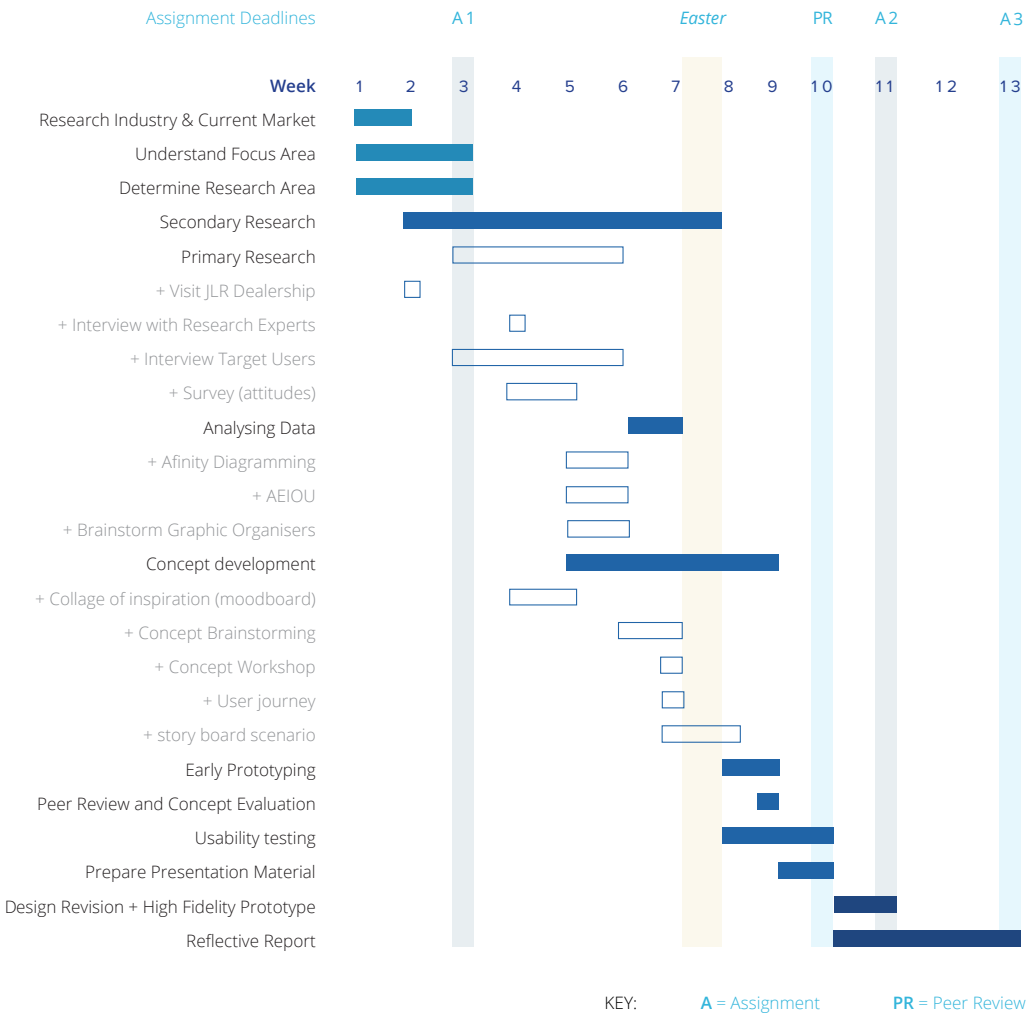
The Autonomous Driving Environment.
In today's climate 2016, most vehicles currently sit between L1 and L2. This gives us as designers an good indication of where the levels of control and ultimately trust are currently at, with users.

WHERE WE ARE - 2016

- L0 – No automation
- **L1 – Function specific automation**
- **L2 – Combined function**
- L3 – Limited self-driving automation
- L4 – Full self-driving automation

WHERE WE ARE HEADING - 2030

- L0 – No automation
- L1 – Function specific automation
- L2 – Combined function
- **L3 – Limited self-driving automation**
- **L4 – Full self-driving automation**



Process: Planning

Gantt chart

To enable our team to have a clear structure to our time as a group and our own individual allocated time on the project, we devised a Gantt Chart at the beginning of the process. We noted all the key stages of the process before we planned how much time we would spend on each. The gantt chart provided us with a useful structure and understanding of where we should be in the process and how much realistic time we should be giving to any one area.

As the scope of the project expanded we did have to alter our time commitments to suit areas where we felt more time was required. These were important considerations which become highlighted once a project is underway. In order to improve the flow of the team and project we made time changes to allow for:

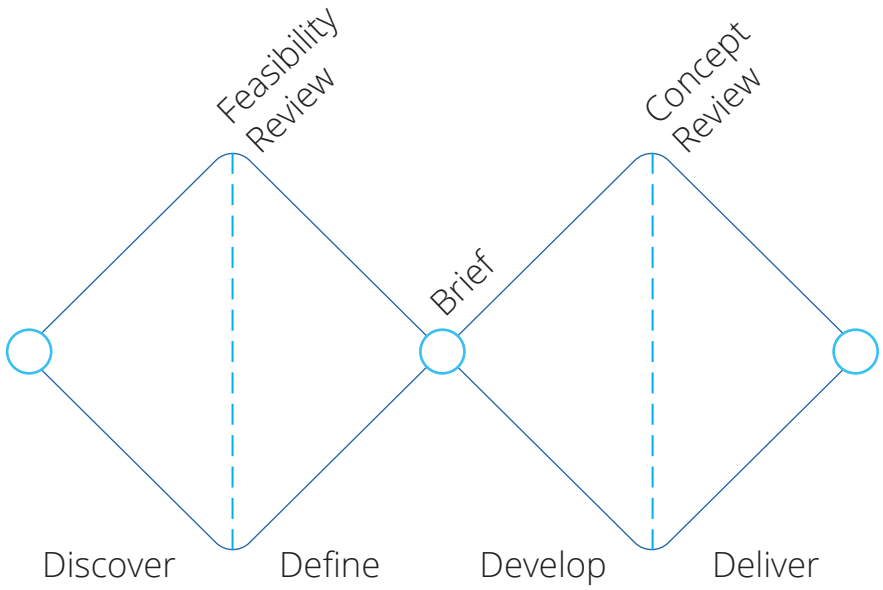
1. *Improving the team's collective understanding of where were at and where we needed to focus.*

2. *Allowing for research set-backs, from what we had anticipated.*

Process: Planning

Double Diamond

The double diamond design process and principle, is a way to focus on all the elements of the design process and understand what is required. Importantly, and in the case of group work it is a method to work to where we can all identify at what stage we are at in the design thinking process. We followed the design process where in the first stage DISCOVER, we looked at user and behaviour led design research; secondary and primary. Next stage we DEFINED the problem we are about to solve, following on is DEVELOPING low-fidelity concepts and ideas before we moved on to DELIVER high-fidelity prototypes and wireframe of our final concept. Throughout this booklet there will be clear reference to what stage in the process we were at, using the double diamond process and strategy.

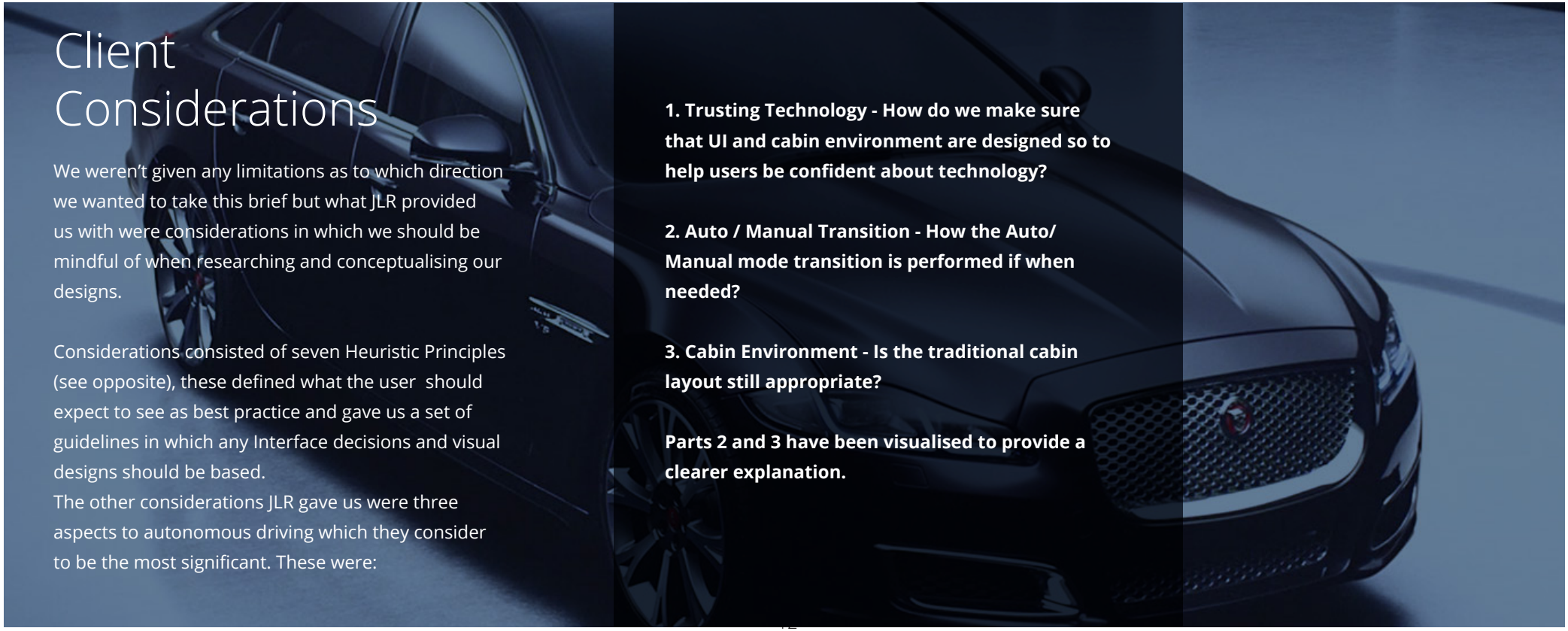


The Brief

Brief from Jaguar Land Rover

Jaguar Landrover (JLR) came to us with a very exciting proposal - they wanted us to explore autonomous driving and how they would look and feel to the user.

As autonomous vehicles are future thinking and won't be mainstream JLR were keen for us to be innovative in our approach and apply 'blue sky thinking'.



Client Considerations

We weren't given any limitations as to which direction we wanted to take this brief but what JLR provided us with were considerations in which we should be mindful of when researching and conceptualising our designs.

Considerations consisted of seven Heuristic Principles (see opposite), these defined what the user should expect to see as best practice and gave us a set of guidelines in which any Interface decisions and visual designs should be based.
The other considerations JLR gave us were three aspects to autonomous driving which they consider to be the most significant. These were:

1. Trusting Technology - How do we make sure that UI and cabin environment are designed so to help users be confident about technology?

2. Auto / Manual Transition - How the Auto/ Manual mode transition is performed if when needed?

3. Cabin Environment - Is the traditional cabin layout still appropriate?

Parts 2 and 3 have been visualised to provide a clearer explanation.

Heuristics

Considerations from Jaguar Land Rover

Visibility

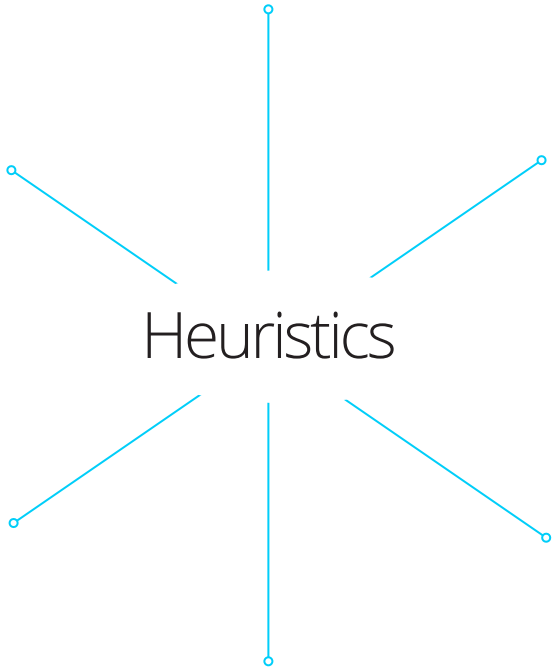
Controls should be made visible and located where users expect them to be

Affordance

Visual cues should be used to help understanding how an object/control can be used

Feedback

Users should be given confirmation that an action has been performed correctly (or not correctly)



Consistency

Things that look similar should do similar things

Constraints

Systems should be designed with restrictions so to minimise margin of error

Mapping

Provide a direct correlation between controls and real-world objects

Heuristics are a guiding set of design principles, closely associated with HCI and Interface design. In relation to our project and design development they ensured an accurate way for us to measure our designs and provided us with a checklist at all times. This was refereed back to as we went, they are noted and can been seen in the design iterations we made throughout.

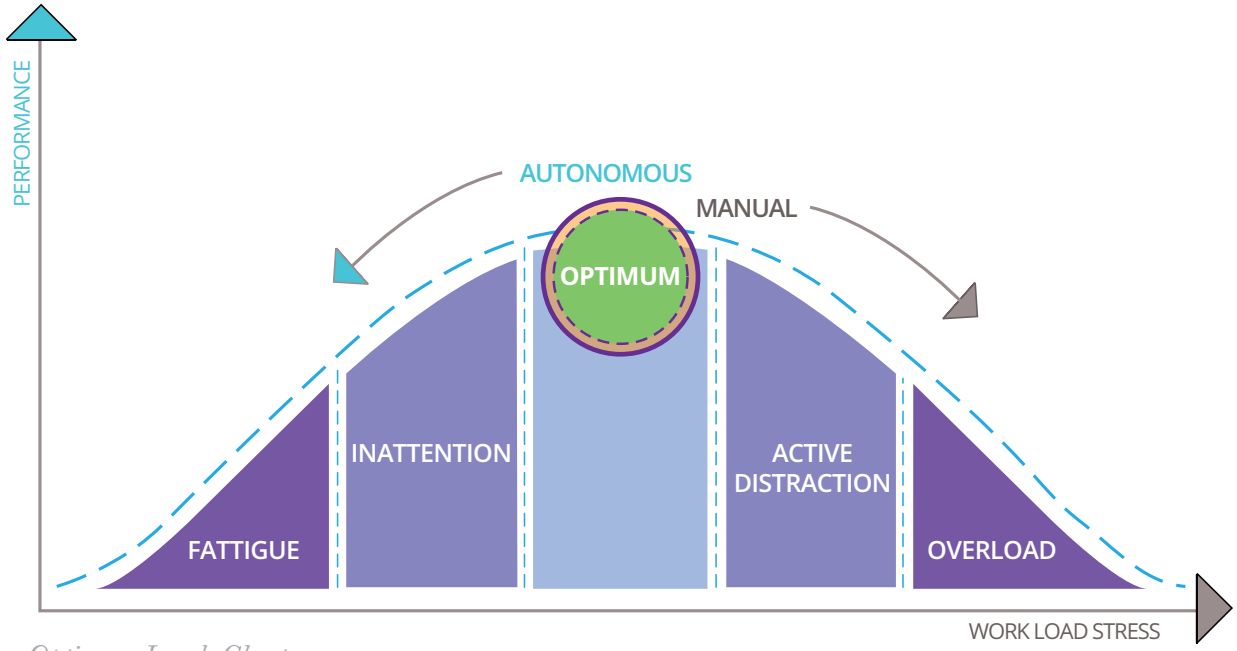
Optimum Levels

Considerations from Jaguar Land Rover

When designing for the transition between manual and autonomous there needs to be consideration to the optimum levels that the user experiences. The chart below represents the complexity in where these experience levels are. As designers it is important that we ensure there is a balance between these so that when the driver moves into autonomous mode there is enough attention required by the user to not become overly detached from their autonomous environment for example, falling asleep but equally the work load stress associated with manual driving does not overload the driver, so in turn they then feel over stretched in what is required of them leading to an induced stress.

The reason why this is so important when we look into the design of the system is there will be a transition from manual to autonomous and vice versa. Maintaining the optimum levels is key to ensuring trust and safety.

In the situation of autonomous driving vs manual driving, we were advised by the client to be mindful of where those friction points were and to consider these in our concepts and designs.



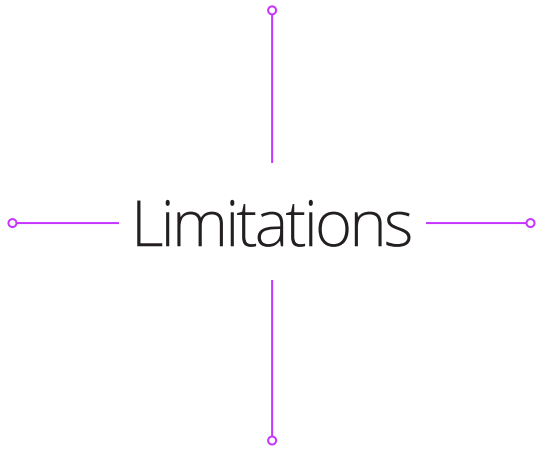
Optimum Levels Chart

Group Reflection

Limitations Identified

At this early stage in the project, we became aware that the scope of what we would need to look into was something new and also complex for us as a group to get to grips with.

Early on in the project we identified areas that we needed to understand more to overcome any group learning challenges. This early analysis of our own limitations helped us be more specific with what we needed to do and equally what we needed to be more mindful of in our research process



1. Understanding Autonomous

We needed to recognise our own learning curve into this subject as none of us knew what this was and the differences in the driving environment levels, given to us bythe client

2. Future Forecasting

Primary research would be challenging, especially when forecasting in the area of what the users of 2030 would think, feel and why that is.

3. Blue Sky Thinking

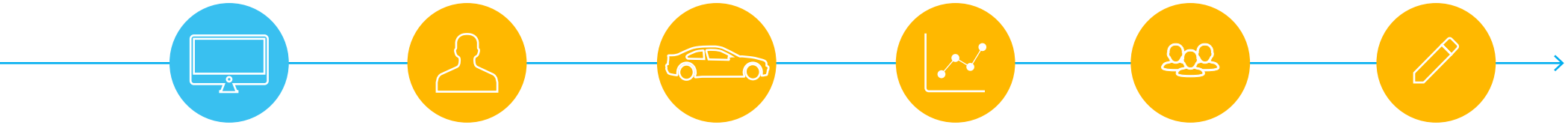
There were no boundaries, our client had wanted to not limit us so we would be innovative. However, we knew early on that we would need to establish our own so the project had a manageable scope, we were all comfortable with.

4. Time Considerations

We have 12 weeks from start to finish so we needed to be mindful of our time and how we distribute the tasks and realistic goals between the group.

Research Methods

Applied learning and understanding process



Secondary Research

Online research and subjective group research into the automotive industry and future trends

Primary Research

Contextual, qualitative research

Visit to JLR Dealership

Visit to Sturgess Jaguar Land Rover dealership – interviews with staff members and experienced the latest JLR vehicles

Survey Target Users

Quantitative Research

Focus Group Discussion

Semi – structured group discussions with our target user age group

Interviews Target Group

Eight Interviews conducted with both target group and expert researchers within the field autonomous vehicles

Moodboard workshop

Secondary Research: Understanding the field

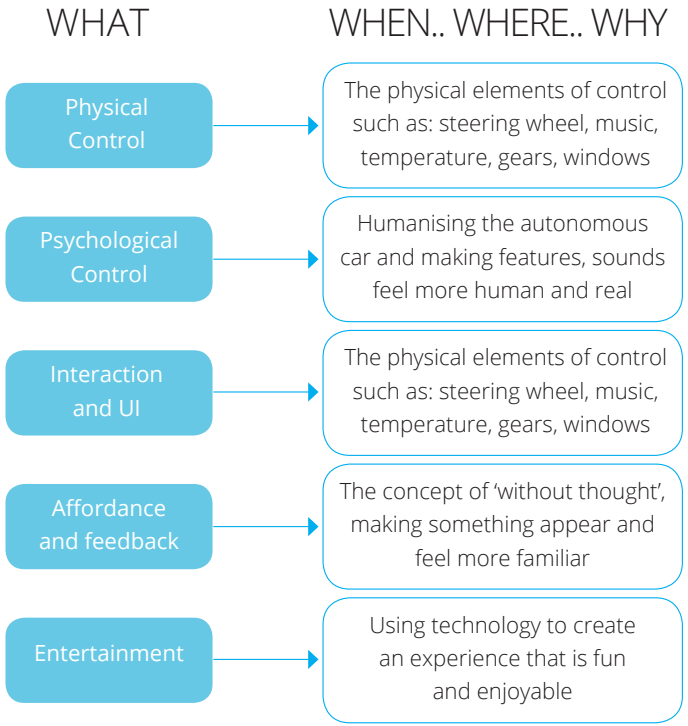
Moodboards are a very useful way to visualise thoughts. They are especially useful in teams when there are naturally different perspectives and interpretations of the same idea. As an exercise to understand autonomous driving and future forecasting, we printed out a series of pictures of future cars, interfaces, designs, fabrics, car environment to get some inspiration of how 'blue sky thinking' could help our own thinking and project. We tried to cluster some of the pictures into the usability heuristics: affordance, visibility, mapping, consistency, error handling and flexibility to see how we could use this later in our design development phase.

Secondary Research

Understanding the field

We needed to establish a clear and defined approach to how we were going to move forwards and set boundaries within our own research and direction, so we could overcome some of the earlier limitations we had identified.
Using what we had been given as considerations from the client, we brainstormed areas of trusting technology / manual to auto & auto-manual transition and the cabin environment and thought about how these might be for the user of an autonomous vehicle.

We mapped our own thoughts out in an affinity style process so we could reflect on what was resulting in recurring and the strongest themes.
By doing this it enabled us to have clear and strong 'How Might We'? questions, which helped to narrow down our focus and define the area where we felt was the strongest in terms of user experience design and interaction design and possibilities.



Team brainstorming exercise

Affinity mapping our own group thoughts

Secondary Research

Desk Research

Our Approach

Group Direction

We decided on a focus area and approach for the remainder of the project. This had been a result of all of our research and analysis to date and something we felt would resonate the most with when talking to target users. It also addressed the considerations from what had been asked of us from our client JLR.

HUNT STATEMENT

Based on preliminary research, the overarching theme of **TRUST** is most important and critical consideration to carry forward. By focusing on trust we can design the L3-L4 environment to feel safe and humanise the overall experience for the user.

Visit to Sturgess JLR Dealership

Primary Research

Customer sales staff are at the forefront of the customer wants and needs and they are a very useful source of research as they see first hand, above any survey or statistic what real people want an equally what their frustrations may be.

As a part of our primary research we visited a Jaguar Land Rover dealership in Leicester to get more information about the cars and its' users. We wanted to learn about the demographics of today's buyers, what features do their customers respond positively to within the latest vehicles and how have customers responded to releases of new cars; were customers adaptable or did they steer towards what they were familiar with or alternatively, what was 'in trend'.

Before the visit we devised a series of questions which we believed were applicable to our area of research, known as a structured interview. However, once there we also used promoted reflection where by we asked the staff to explain in more detail a story or situation they had encountered with customers to the showroom or customers elsewhere.

Typical questions included:

- What are the differences between customers of Jaguar and customers of Land Rover?
- What are the biggest changes you have noticed over the last couple of years in terms of buyers needs and desires?
- What types of question do you get asked by customers who visit the showroom?
- What aspect of the car do they try to sell? (functions/specifications, prestige, practicality etc)
- What types of UI entertainment do their cars have and how do they operate?
- What are the most popular features and functions in JLR vehicles?
- In what context do you believe it would be safer to be driven in an autonomous car?
- Do customers express concern over the current L2 capabilities in JLR vehicles?
- Where do you in your professional opinion, see the greatest area for change in consumer buying behaviours of JLR vehicles?

Visit to Sturgess JLR Dealership

Primary Research - Findings

LAND ROVER FACTS

• The age group of Land Rover buyers is getting younger. It is not uncommon for someone in their 20's to visit their showroom and make a purchase

• Customers of Land Rover come from a wide range of backgrounds and lifestyles:
business, farming, families

• Women are buying more Range Rovers with the Evoke model proving popular due to it's compact design, smaller windows and different seating levels making it more appealing and feel safer to women in particular

• Customized service (consumers can build their own cars)

• Land Rover is seen as better for autonomous development because it is more practical a vehicle compared to the Jaguar.

JAGUAR FACTS

• The age group of Jaguar buyers is getting younger, down from 45+ to 35+ this has largely due to Jaguar designs changing to be more softer and practical, rather than the hard lines and squared styles of previous models

• The types of customers of Jaguar are usually people who own their own companies or business

• It is seen as challenging to go fully autonomous, as the driver experience is a big part of owning a Jaguar, especially with their sport cars as they will always want to be driven

Survey

58 participants on Typeform

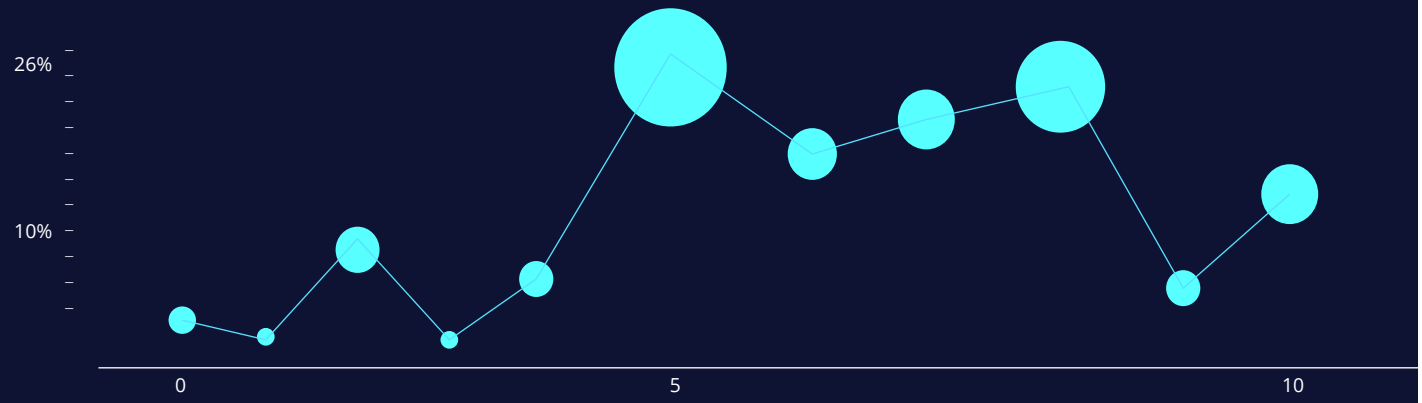
In order to design for future users; users in 2030, we will have to understand and take into consideration how today's users think and feel and cross compare that with our secondary research; what we know of the design and thinking in autonomous drive vehicles.

To do this we used a survey to conduct quantitative research to get more insights into the feelings and issues surrounding trust when it comes to driving an autonomous car. The survey had 58 participants who were evenly distributed between the sexes. (Appendix 1)

We looked into the context in which our target group would feel safe or safer in a self-driven car and equally looked at when they wouldn't, trying to determine where there were overarching feelings of mis-trust and also where we saw the greater opportunities were to carry forward into concept design ideas.

In which scenario would you feel safer driving an autonomous car?

How much would you trust an autonomous car?
(0 - no trust, 10 - fully trust)



Target User Group Sampling Methods

Methodology

The sampling method we chose was for 3 of our participants was to interview target users who would be the future JLR customer in 2030.

As a part of our primary research we visited a JLR dealership in Leicester to get more information about their cars and the typical customers/buyers that they are more familiar with now. We asked about the demographics of today's buyers; what are important features to the users and how they have previously responded to new releases of cars.

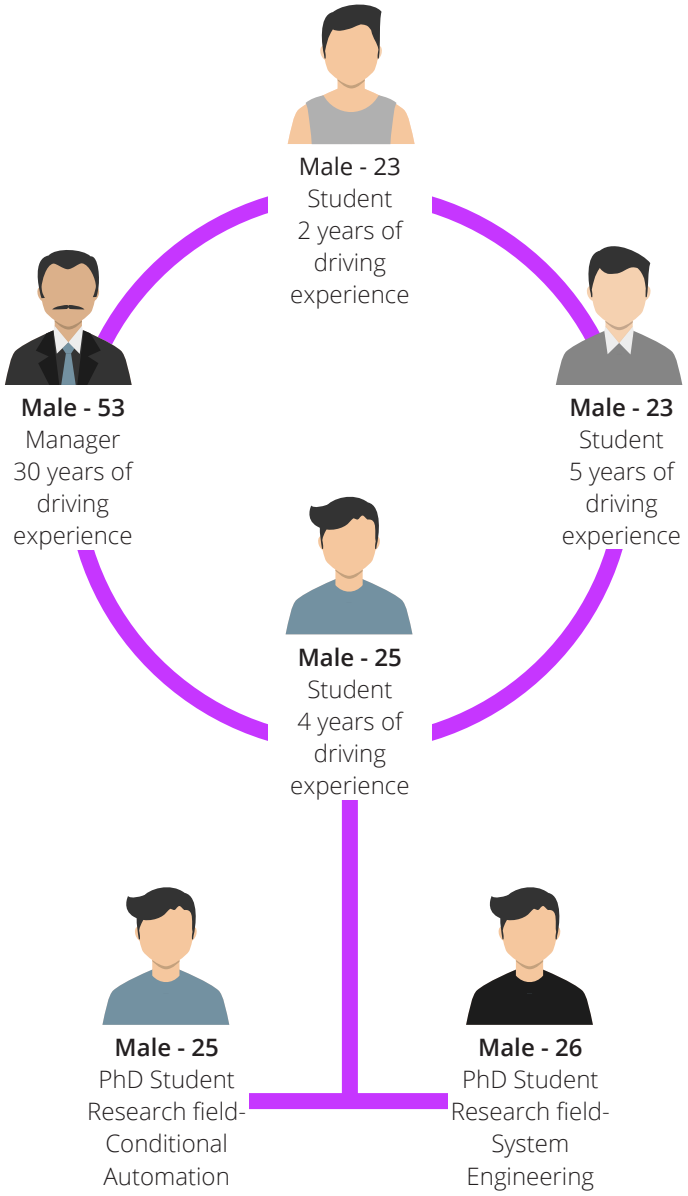
We learned from our visit that their customer demographic is getting wider. It is now not unusual to find JLR owners from the age of 35 onwards. Ten years ago their typical customer age group would have started from 45 years and upwards.

By sampling and interviewing participants in their 20's, it achieved two things; to speak to today's target group age (generation Z) and to ask the same target users how they feel about technology and autonomous cars, based on the reasoning that they will be the 35 year old demographic by the start of 2030.

Referring back to the earlier limitations described in this booklet, we felt that this was the best approach in us being able to reach out and future forecast on user needs and goals fourteen years from now.

We also interviewed a man whom was in his 50's but we learned had experience of driving an L2, combined function vehicle. Although out of our target group age range we identified that he would give us a useful perspective on his experience of L2. This would be of value to our research so we included him in our sample of participants.

Two further participants were PhD students. One specialised in Conditional Automation in L3 vehicles, the other specialised in System Engineering, specific to vehicle in-car navigation systems. Both of these participants provided us with the technical knowledge which we were lacking and proved to be valuable within our sampling study. Today's younger generation known as 'Generation Z', has been brought up with new technology. They are adaptable to new gadgets and software and are more trusting when it comes to changing technology. User research into technology and what it means for 'Generation Z' will provide valuable data to help us define what L4 could look and how it will be experienced.



Sampling – Participant Demographics

Target User Group Interviews

Methodology

We conducted semi-structured interviews with 4 of our participants. Semi-structured as this was about us learning from their perspectives and gaining insights into their needs, motivations and frustrations. The further 2 interviews were more structured. These were with research students, which allowed us to be more specific to their field of respective research areas.
(See interviewing experts for more details).
With our 4 participants we wanted to gage their different view points with regards to trusting technology, moving onto autonomous vehicles and learning their feelings

"I'm fine with laptops and everything, I just don't like technology being in control of lives" (Male - 53, Manager)

and perspectives of L4. This investigative process allowed us to discuss their expectations on how they felt L4 autonomous cars in the year of 2030 could enable trust and safety, discussing factors such as the UI interactions between user and system and how that translated the cabin environment to the user

In summary, the insights generated from the user interviews showed a positive perception towards technology, however people do not want to feel like they are being controlled by technology. From the interviews, we have acknowledged that people feel less confident when driving under complicated weather or road conditions. They will accept supported autonomous functions which L3 vehicles would offer but do not feel that they can fully trust L4 autonomous cars.

We note that these reflections are based on the current 2016 understanding of L4. As designers on this project we needed to be mindful of how technology becomes something we grow with as it becomes more widespread and accepted. Therefore users current feelings towards L4 needs to be accounted for in our designs, but viewed with a degree of flexibility.

"The idea of all the cars thinking on their own, I'm just convinced that something would go wrong. I wouldn't put any faith in it"

(Male -23, Student)

"I still need a steering wheel that I can control at any time, otherwise I wouldn't feel confident"

(Male -25, Student)

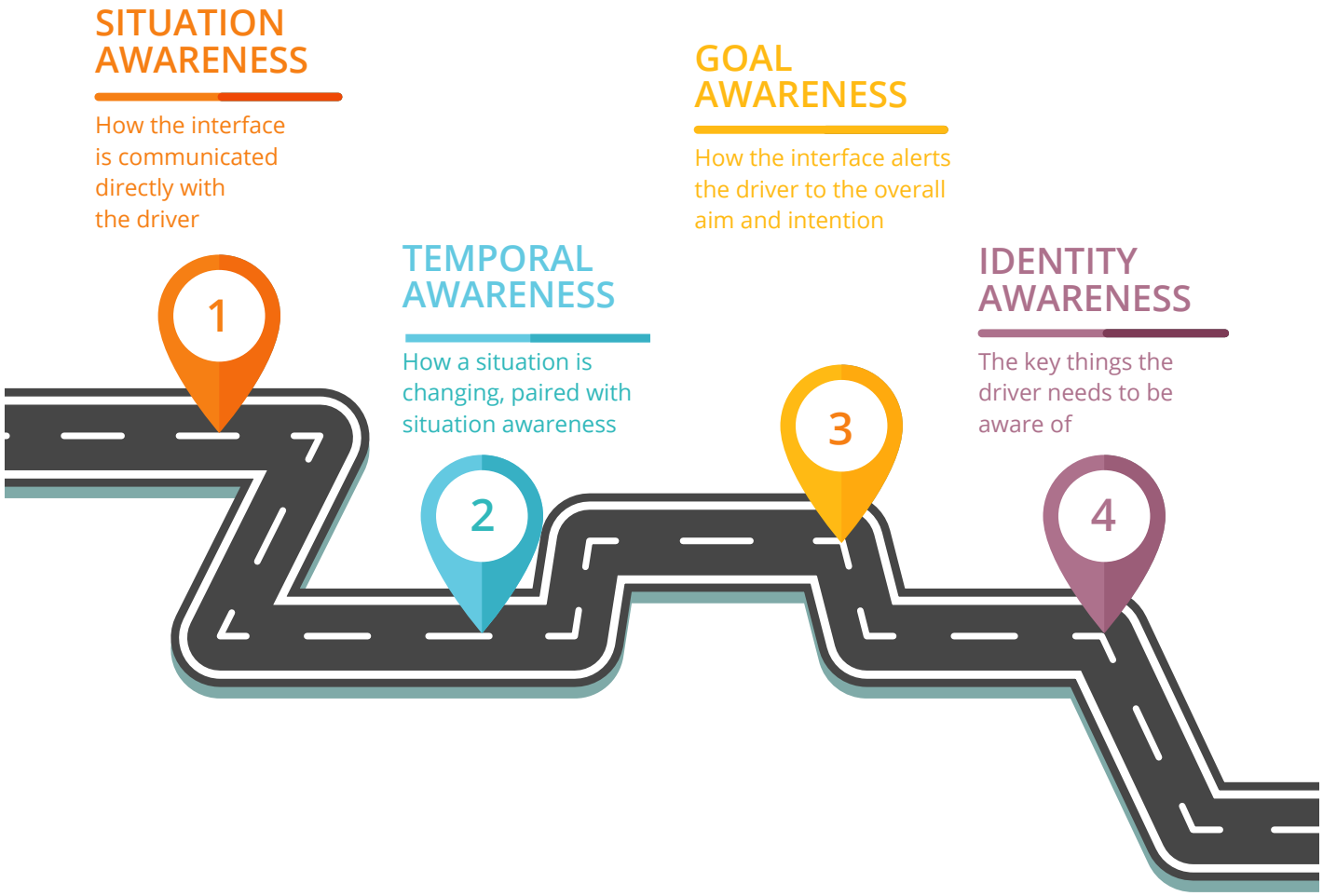
What we did learn which was useful to us when thinking back to the clients heuristic principles was users prefer physical buttons and controls they can see over gesture or voice control to activate the auto-mode.

This was interesting as although users are familiar with gesture and voice in their current smart devices, the need to identify with and feel safe was the knowledge of knowing and seeing a physical button or control such as a steering wheel. This signified a greater level of safety and control to a user - something physical felt safe.

In addition, they would still like to be able to take charge at any moment when driving in autonomous mode, since there are seen as too many potentially hazardous situations that can happen in driving in real terms.

Four Perspectives of Situation Awareness

Primary Research



Interviewing Experts

Primary Research

We interviewed two PhD students, one as mentioned in the field of autonomous driving, specialising in Conditional Automation. Their focus was to look at ways of improving Situation Awareness (SA) in vehicles with autonomous capabilities (SAE levels 3 and above). Focusing specifically on designing interfaces which help to reduce the time required for a take-over-request (TOR).

We understood that there are 3 perspectives to Situation Awareness (SA) which are all defined as perceptual elements; cues in the environment that inform the driver or human being to the situation around them. These 3 perspectives cover:

1. Perception - predict a situation
2. Comprehension - understand it
3. Projection - act out or foresee that you will do something

To understand these in the context of a driver/system environment - broken down in SA you have -

1. Situation awareness
2. Goal Awareness
3. Temporal awareness
4. Identity awareness

(See opposite for definitions).

This insight was very influential to us as a team in how we interpreted our design concepts and wireframes. We began to think about the levels of trust, of which there are many and in different user situations.

Trust is a very hard thing to define, it can be argued that it is subjective to each user. Then there is the complexity of trust in a system. For example take-over-request (TOR) time for L3 systems are currently 5-8 seconds. However, we learnt that research has found human beings need 40 seconds to respond after a period of doing nothing, so there is already a critical problem there. Also in the case of what and who we are designing for, this system is years ahead of us in 2030, so again referring back to our identified limitations, we had to apply intelligent assumptions based on what we knew and what we were trying to resolve.

Being Subjective

Primary Research

We initially applied the research we had learned from experts into our design thinking and low-fidelity concept designs, taking into consideration TOR times and what the research identified about human cognitive behaviour. However, we decided early on into the conceptual design development phase that we would (for example) use the current TOR times of 5-8 seconds and not move away from what is being applied and tested in L3 and L4 driving environments.

As designers we learnt to be subjective within our research and also in the time frame we had. Being too critical of current standards, which was influenced by expert research meant a greater time commitment on our part, something we didn't have in the project and specifically concept design phase.

What we found is by understanding SA, we were able to break 'trust' down and think about what critical information a user would need to understand and what a system would need to provide for the user. Using our research, we defined a scenario and a narrative which took into consideration the levels of SA and used these to help guide us in our approach and vision.

Dinner Discussion

User Research : Generation Z

We had a group discussion with three undergraduate students who had different levels of experience with cars and autonomous technology. This was to get an insight to Generation Z's attitudes and feelings towards being driven by an car instead of driving it. The discussion gave us confirmation that the users would have to be able to override the system, and take control at any moment. They also raised a lot of questions to take with us in our process, like multi car hacking, external conditions like weather and unforeseen events.

> ***Wouldn't trust that much in technology - would have to be able to take control at any time***

> ***What about hackers - I want to know who is controlling my car***

> ***Who would you blame if something happened?***

Data Analysis

Making sense of user research

At this stage in our process we needed to collect all our research, our thoughts and delve deeper into what we had understood and gathered from all our sources. We began the process of formulating some early solutions to the insights, being mindful of what our client had asked us to consider and also our own vision for this project.

We were keen to start conceptualising some interfaces and to see how this could benefit the feelings of trust for our target user and humanise their experience of the L4 driving environment.

Data Analysis

Affinity Mapping

Affinity mapping was a useful way for us to understand a large amount of data. After collecting insights into words and short statements, we were able to understand where recurring patterns and themes were present. We then identified these under more defined headings to understand which specific areas we needed to focus on and take forwards into design development and concepts.

This process of data analysis was helpful in us understanding where the patterns were in our future forecasting. By identifying similar needs and equally concerns we could map out a strategy to help us understand where the best areas for concept generation would be.

Insights to Opportunities

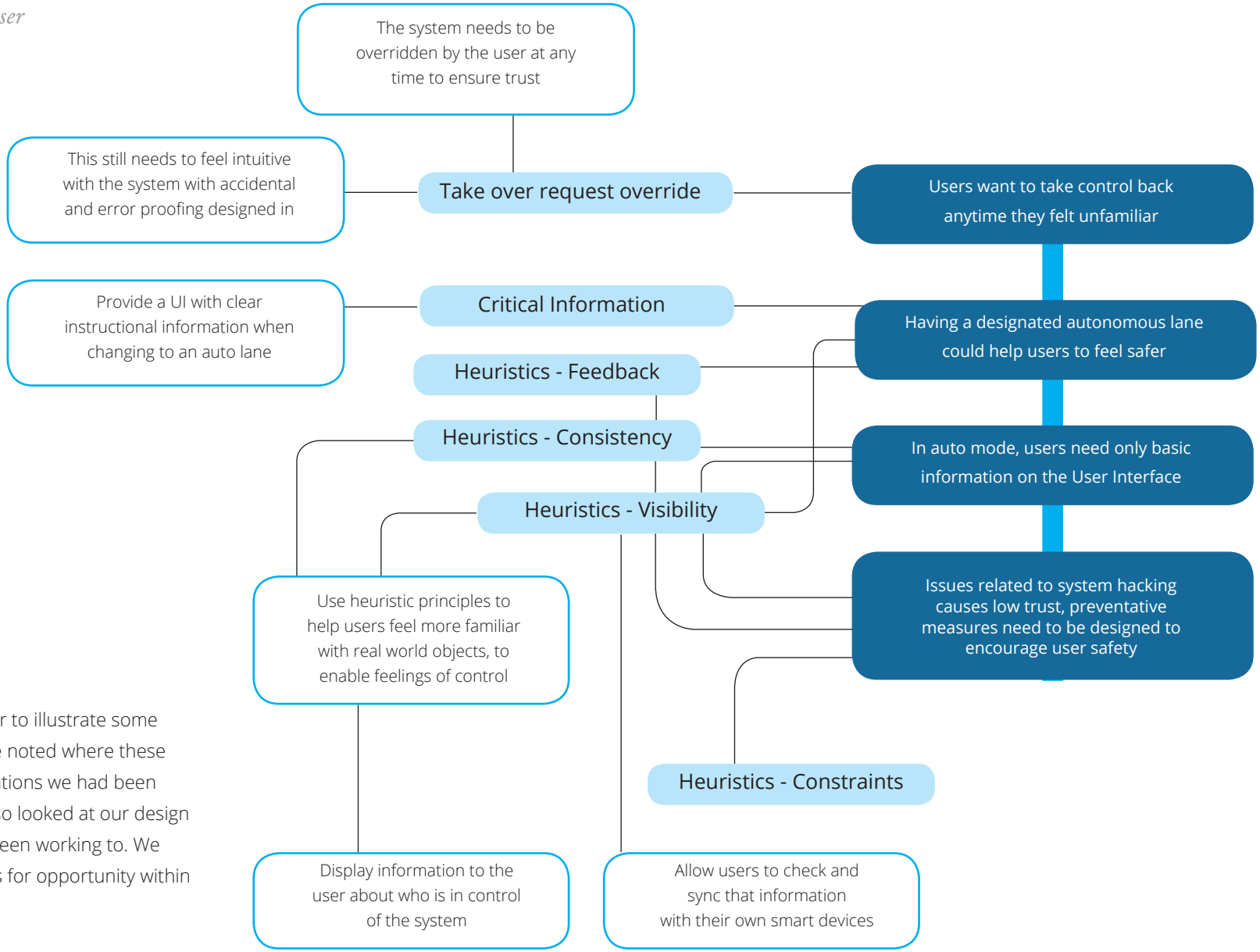
Understanding the Opportunities

As we were moving through the discovery stage of the project we had identified insights along the way. These had come from all of our research sources. Using a brainstorm graphic organiser approach we were able to define what opportunities were coming from the insights, and formulate these into real context solutions which fitted in with our own design vision and approach.

Insight	Opportunity
HUMANS ARE BAD PASSIVE MONITORS	TO DESIGN A SYSTEM WHICH COMMUNICATES CLEARLY AND QUICKLY TRUST AND SECURITY
IN L3 - YOU ARE TAKING THE PRIMARY CONTROL AWAY FROM THE HUMAN	TO ENSURE THE SYSTEM IS AHEAD OF AND MORE INTUITIVE THAN THE USER
KEEPING THE DRIVER AWARE IS ONE OF THE MAIN CHALLENGES	THE DRIVER NEEDS TO SEE ONLY CRITICAL INFORMATION, LEAVE OUT THE REST
USERS ARE DISCOURAGED IN SYSTEMS TOO TECHNICAL, THEY WANT TO TAKE CONTROL BACK AS THAT FEELS MORE FAMILIAR	USE HEURISTIC PRINCIPLES TO HELP USERS FEEL MORE FAMILIAR WITH REAL WORLD OBJECTS, TO ENABLE FEELINGS OF CONTROL

Data Analysis

Brainstorm Graphic Organiser



Brainstorm Graphic Organiser to illustrate some of the insights we identified. We noted where these matched to the client considerations we had been given, namely Heuristics. We also looked at our design development process we had been working to. We were able to identify clear areas for opportunity within our concepts.

Persona

Representative user 2016 – 2030

Generation Z are the current 18-24 year old, who will be between 33 to 39 years old when L4 is widespread and predictably mainstream in many of of the car designers and manufacturers we see today.

Much of what we are working on is based on future forecasting, with the knowledge that full autonomous (L4) vehicles will be in operation in 2030.

With this in mind we have created two key persona's; one we can reflect on in the present day 2016 and the other will be the same person projected into the future and into the year of 2030. By doing this it helped us understand what the key lifestyle and experience differences will be from users in today's knowledge and understanding of L2-L3 vehicles, then projecting into the future and understanding what that same user's lifestyle would be and how their familiarity with technology would enable them to understand automotive advancement in relation to L4 vehicles.

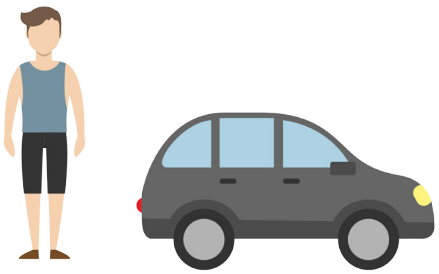
2016

Michael -Student

21 years old

- Streams music for Uni projects and for personal use
- Drives his mum's car when he is home from uni and likes the adaptive cruise control
- Owns lots of tech devices and likes going to tech and gadget events

Needs: Strong wifi signal
Frustrations: Slow drivers
Experience Goals: To buy his own car



(FUTURE PROJECTION)

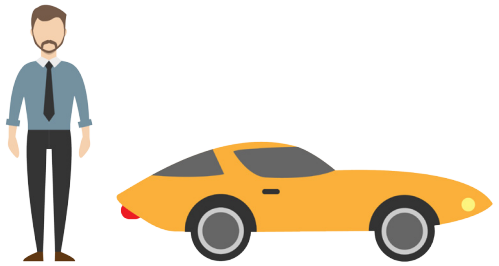
2030

Michael - Haptic Programmer

35 years old

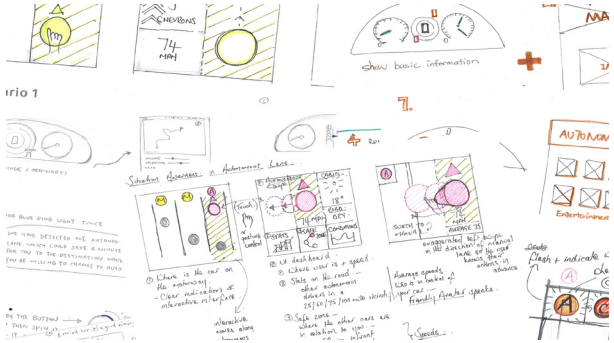
- Father of a 2 boys, aged 3 and 5 years
- Works with science and touch technology to develop products and services
- Enjoys collecting vintage vinyl
- Spends his spare time using AR at home to experiment with new ideas

Needs: A good UI system in vehicle
Frustrations: Slow drivers
Experience Goals: To be able to work from his car during his journey into work.



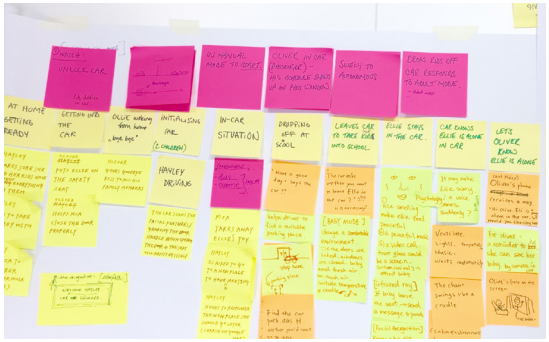
Scenario

Building our scenario



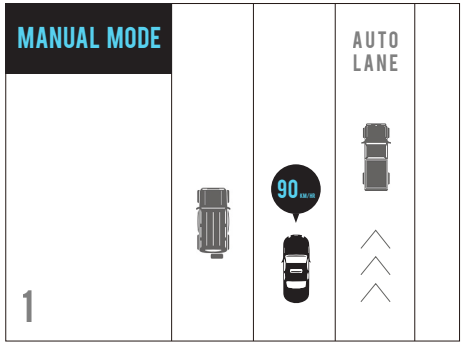
1ST STAGE

Before we started wireframing we needed to understand what scenario we were designing for. We used our persona Michael as a user in the scenario and brainstormed how his journey to work one morning would play out. The scenario starts when Michael is at home and ends when Michael is at work. We tried to design all human-machine interaction and use the usability heuristic to enable trust in the scenario. We discussed how he would open the car, start the car, drive and park the car. We soon found out that the scenario we had was too complex and that we needed to narrow it down to a specific situation.



2ND STAGE

Instead of everyone doing their own interpretation of the scenario we decided to build the scenario together as a group. We made a mock-up persona of a family that was driving to dropping of their kids on their way to work. This helped us to see the bigger picture of the journey we would later end up with. Unfortunately, this scenario was also too complex.



3RD STAGE

Our third workshop on our scenario we tried to think about situations in stead of a whole journey to keep it as simple as possible. We came up with three situational scenarios.

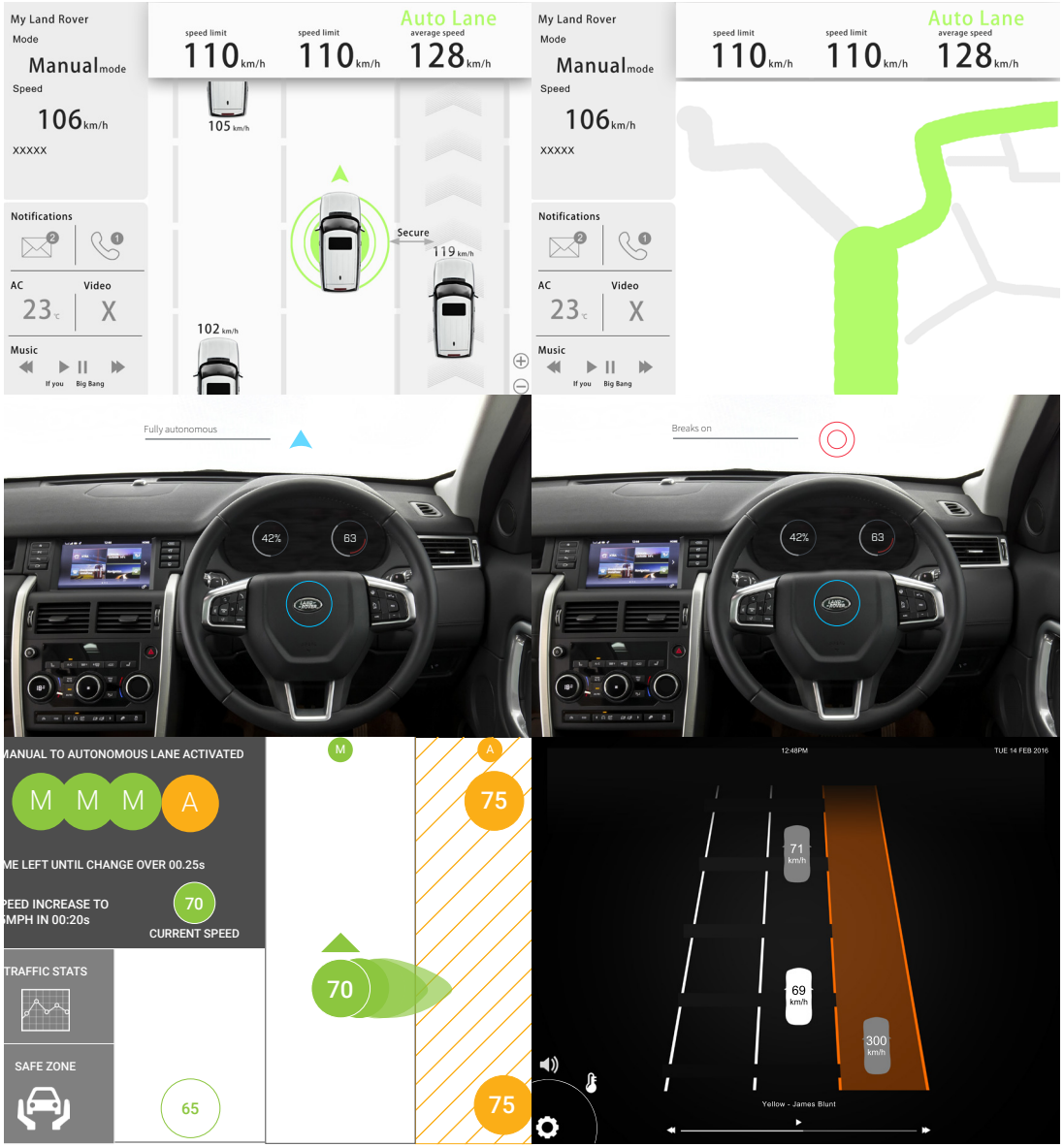
1) The driver is at home, gets into the car and starts driving
2) He is driving on a motorway in Manual mode - change to Auto mode
3) Situation occurs - He needs to go back to manual mode

Client feedback

We presented our three scenarios for the client and got some useful feedback telling us to narrow our scenario even more to be able to design the details of interactions. On the other hand, it is more important to focus on a narrative instead of details in a wireframe, to make it more human-centered. We were told to tell the story.

Key deliverables

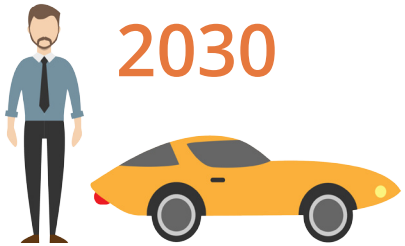
We spoke to the client about what we would deliver by the end of this module and we agreed that wireframes and an animation would be suitable for out project. This way we can show how the different interfaces chages through a spesific scenario.



Wireframes : sketches from 3rd stage of scenario developing.

Scenario

Methodology



We created a scenario for our persona to help narrow down our design process and think about how this would be for both user and system

In 2030, we know that L4 capabilities will be in most cars. As we learned from JLR, they are trialling an autonomous L4 car using a designated autonomous lane. As we were aware that this was a reality, it was safe to assume that an autonomous lane will be in place and used in L4 vehicles by 2030. With this in mind we devised a scenario whereby the driver of an L3-L4 vehicle can move in and out of the autonomous lane.

The cabin environment will utilise UI information and will have a physical button for the driver to change modes (transit manual and autonomous driving). There are three interfaces which the driver will interact with.

First, the main screen "touch screen" as centre control interface of the car, second the dashboard, in front of the driver and behind the steering wheel, third, a physical button between the steering wheel and the main screen .

The scenario will show features below:

1

When the car is driving in manual mode, how does the driver change the mode from manual to autonomous driving?

The use of a physical button helps the driver feel more connected and in control of the vehicle. This is perhaps a psychological element that will be designed out by 2030, but we applied user feedback and introduced it as part of the cabin environment.

2

When the car is driving next the anto lane, how does the communication process begin with other autonomous drivers and cars?

The introduction of a handshake - a communication between two vehicles much like a computer system is needed so the process of lane moving becomes in sync with all the other autonomous vehicles around.

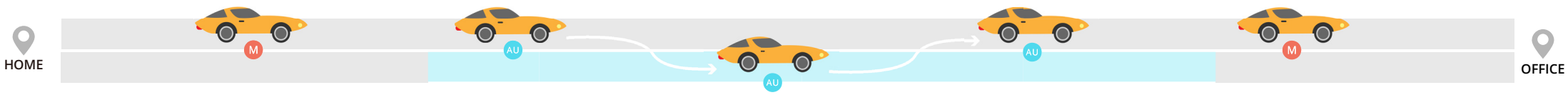
3

When the car wants to move out of the autonomous lane, back to the manul lane what is the process of communication here?

There needs to be a handshake principle again and also a level of security so the driver knows that this process is about to happen. A visible countdown is needed here.

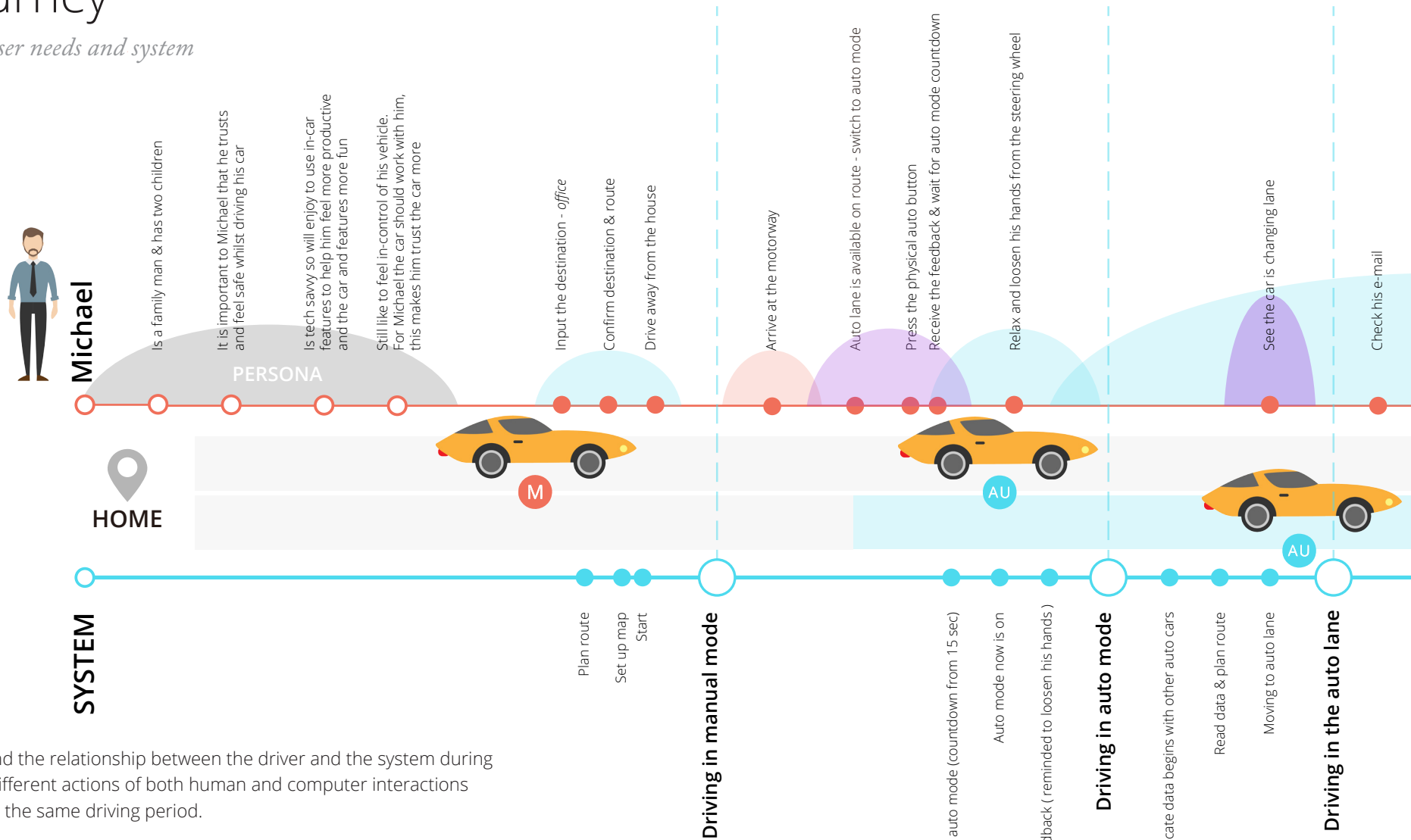
4

Once a driver is back within the manual lane, there will be a take-over-request (TOR), needed so the driver is fully aware of the current situation. What information does the driver need to see to be aware of this. The TOR time needs to be critical and also aware of the current state of the driver, to enable safety. We used various data collection methods to understand our research and define what insights and opportunities we had.



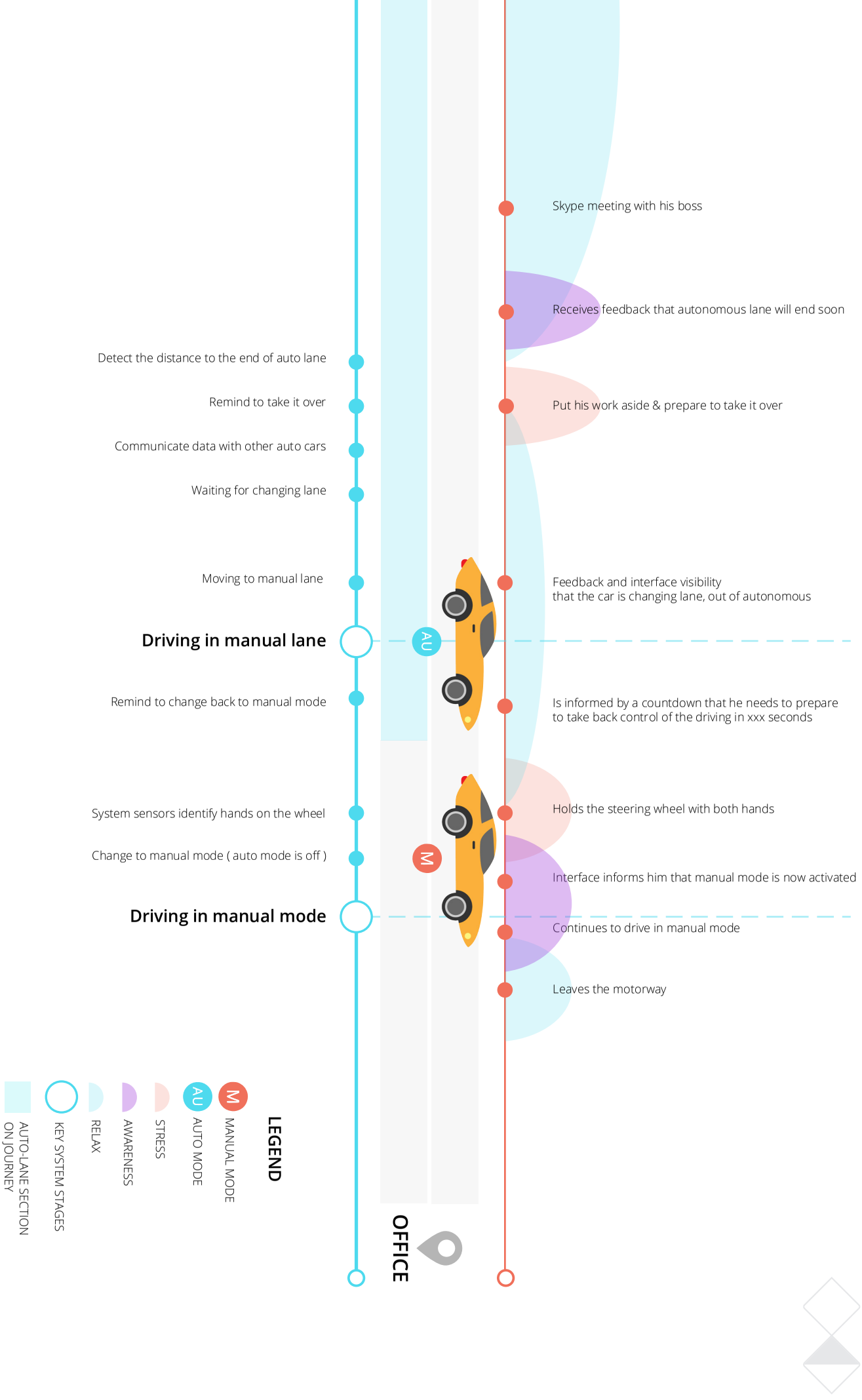
User Journey

Explaining the user needs and system



In order to understand the relationship between the driver and the system during a journey, we listed different actions of both human and computer interactions that would happen in the same driving period.

This helped us to understand what the differences were and how we needed to think about these when we were designing our concepts. As explained earlier, we know that in L3 the primary controller is the system but in order for us to provide a humancentered approach to our design, we found it helpful to know what the system was doing in tandem to how the user would be feeling or what the user needs would be at each stage of the journey.


Skype meeting with his boss
Receives feedback that autonomous lane will end soon
Detect the distance to the end of auto lane
Remind to take it over
Put his work aside & prepare to take it over
Communicate data with other auto cars
Waiting for changing lane
Moving to manual lane
Feedback and interface visibility
that the car is changing lane, out of autonomous
Driving in manual lane
AU
Remind to change back to manual mode
Is informed by a countdown that he needs to prepare
to take back control of the driving in xxx seconds
System sensors identify hands on the wheel
Holds the steering wheel with both hands
Change to manual mode (auto mode is off)
M
Interface informs him that manual mode is now activated
Driving in manual mode
Continues to drive in manual mode
Leaves the motorway
OFFICE
LEGEND
AUTO-LANE SECTION ON JOURNEY
KEY SYSTEM STAGES
RELAX
AWARENESS
STRESS
AUTO MODE
MANUAL MODE

Usability Testing

Testing our concept

We tested our concept wireframes with three students as well as one who we walked through the whole scenario. The feedback we got from the scenario session was very detailed and wireframe specific, however some points were more overarching.

Usability Testing: *Feedback*

We should strip the UI for more details like the speed of other cars, so that the crucial information would stand out more. This was also a consideration from Georgio at our last skype meeting, but we needed to minimize the information load even more.

Make the animations and graphics as intuitive as possible. We had a picture of a handshake between two cars, and we used two hands as a visual, but the user didn't understand what was happening because he didn't know about the term "handshake".

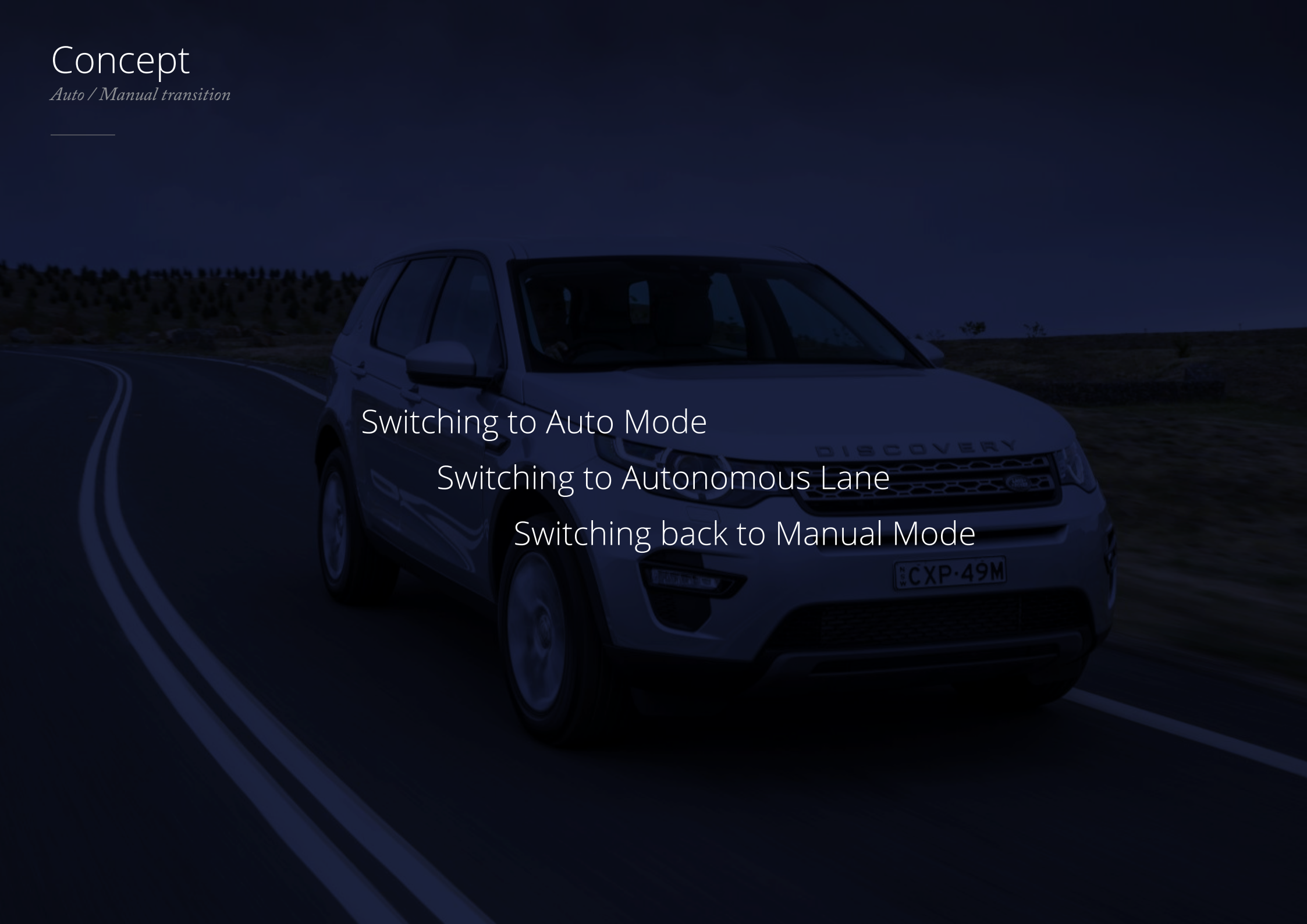
Some of the feedback needs to be more consistent throughout the scenario, to ensure the users are following the actions of the vehicle.

Explain more information with the arrow ahead the car, instead of adding new symbols (for example: go a bit further to the car when accelerate, a bit closer on the opposite; changing direction).

Change lanes could be done automatically by the vehicle, users should be free to do anything they want to afterwards.

Concept

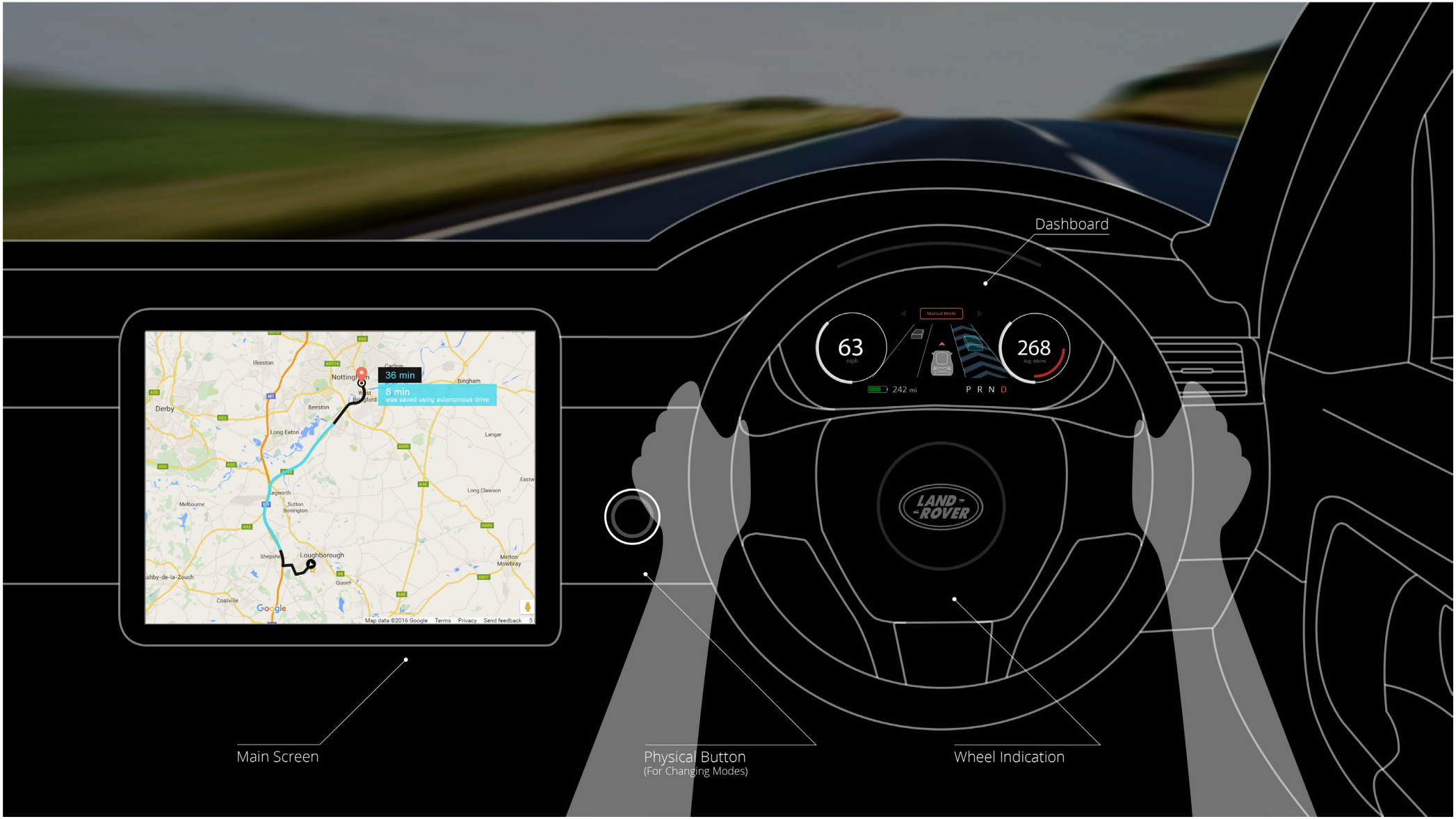
Auto / Manual transition



Visibility

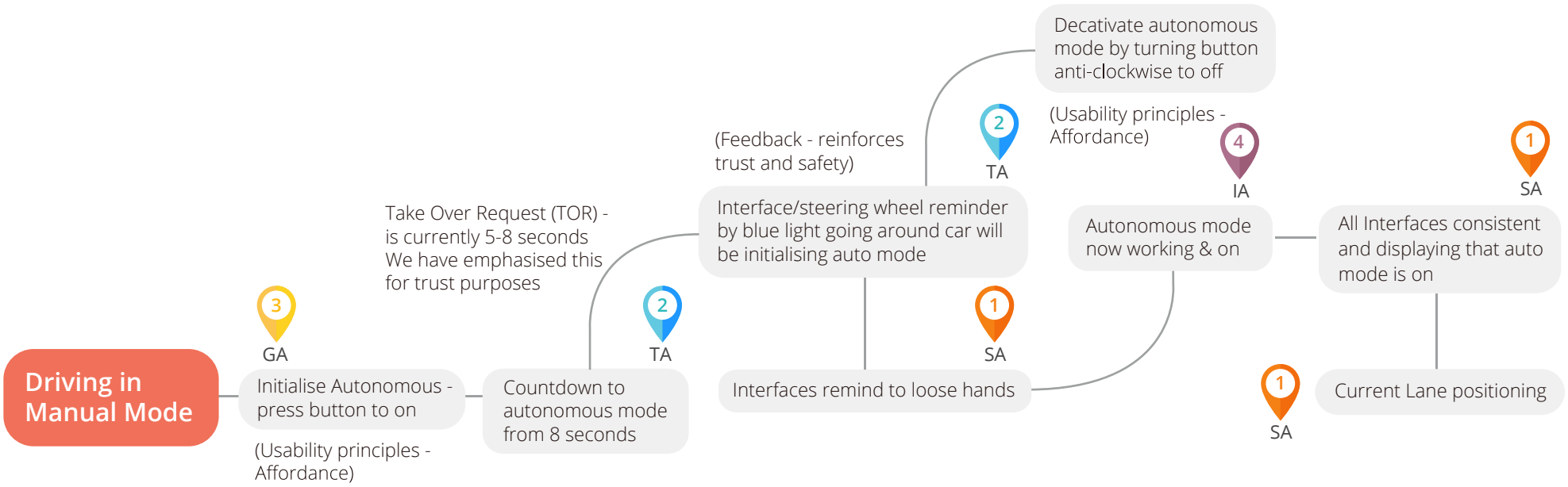
Design principle

At the beginning of the journey, the driver has the option to plot their destination. After that, the shortest route is suggested and includes driving in an autonomous lane. ***The driver will save 8 minutes on whole journey***. The interfaces are shown on both the dashboard and main screen. The screens visibility is good are in a clear line of sight for the driver.



Switching to Auto Mode

User flow



User Flows

In order for us to understand our wireframes better, we devised a series of user flows for each segment of a user journey. What they did were to help us think about each critical and key stage of each decision point and/or alternatively what information a user would expect to see after the system had made a decision.

By mapping out our user flows in this way helped us to visualise what the user-centred approach would look like and enable us to make more informed decisions about what would happen next in any given scenario.

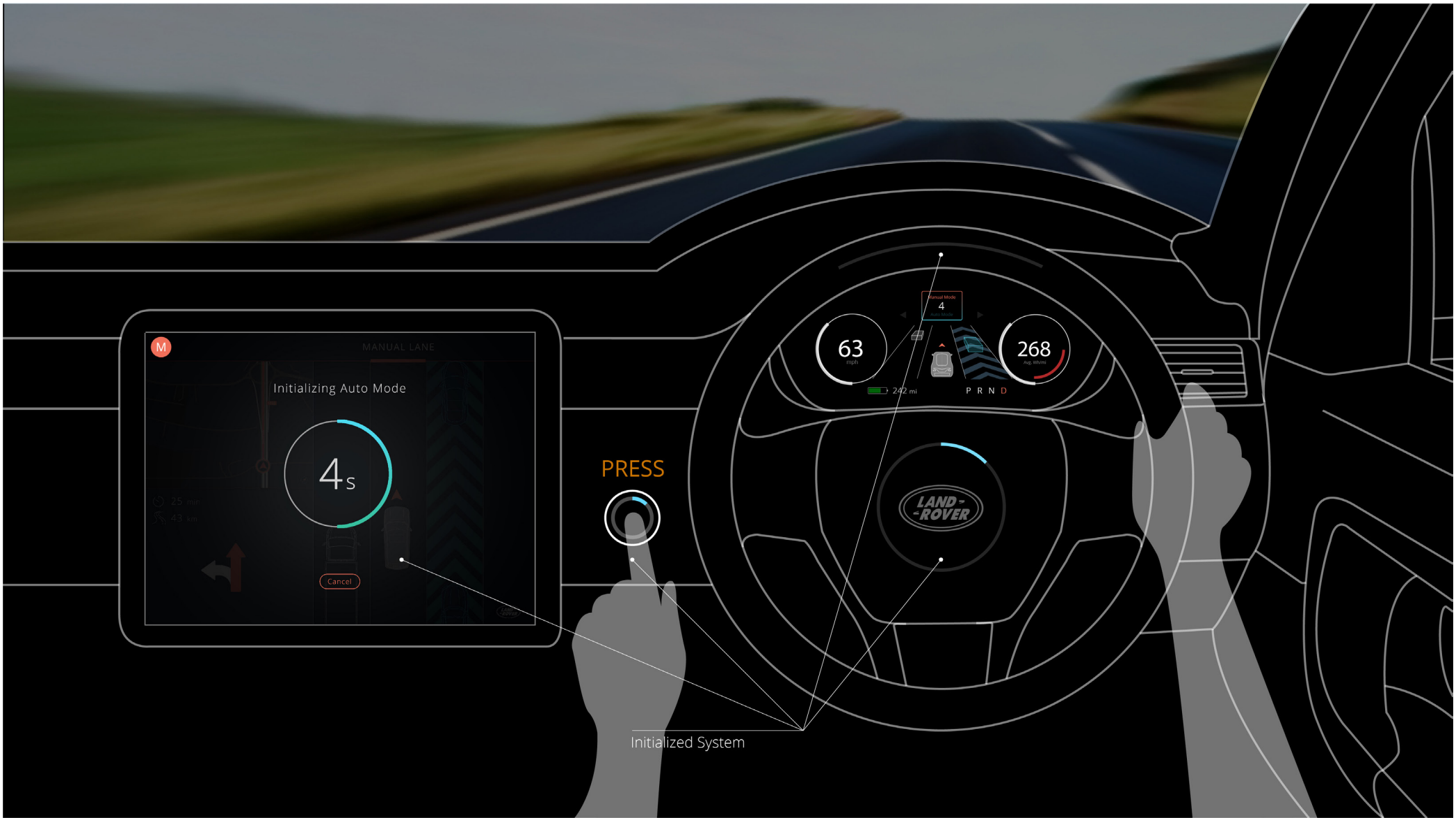
1 SA	Situation Awareness	How the interface is communicated directly with the driver
2 TA	Temporal Awareness	How a situation is changing, paired with situation awareness
3 GA	Goal Awareness	How the interface alerst the driver to the overall aim and intention
4 IA	Identity Awareness	The key things the driver needs to be aware of

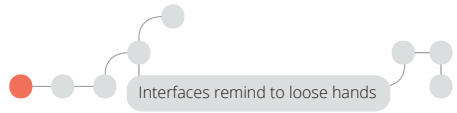
After setting up the journey, the interface shown on the main screen changes to an overview of the motorway.
At this stage, the car is being driven in manual mode by the driver.

Affordance

Design principle

The driver activates the autonomous mode by pressing a physical button. Relating back to research we identified that this was the preferred way to change between the modes, rather than on the actual interface.





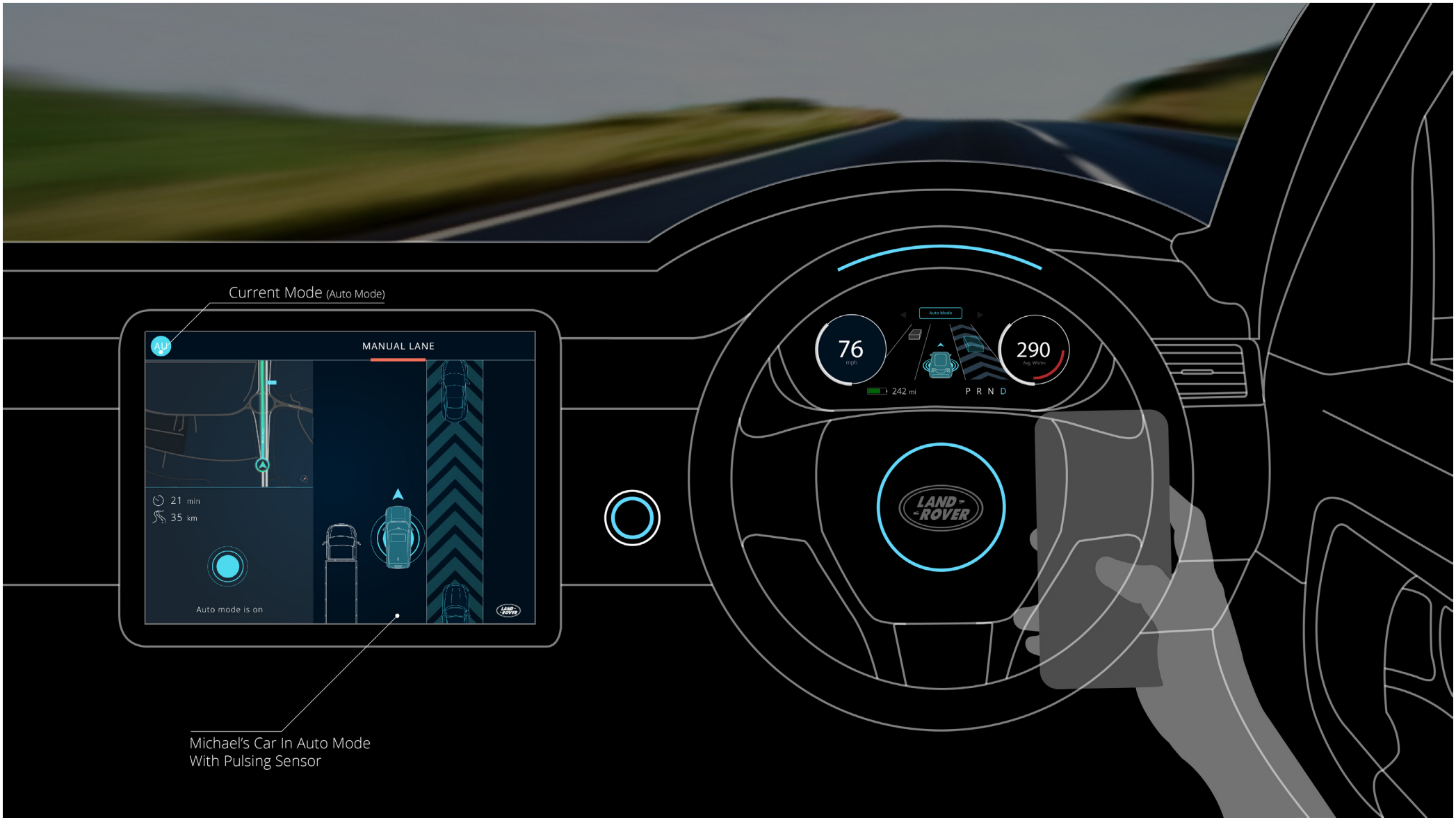
After initializing the autonomous mode, the blue light on the steering wheel gives the driver feedback that the autonomous mode is on. This shows clearly that the car is controlling the steering wheel. The wheel will also move to show that it is driving and slowly move inwards from the user - providing the driver with feedback and visibility to confirm who has primary control. Both interfaces will now show that it is now safe for the driver to let go of the steering wheel.

Visibility

Design principle

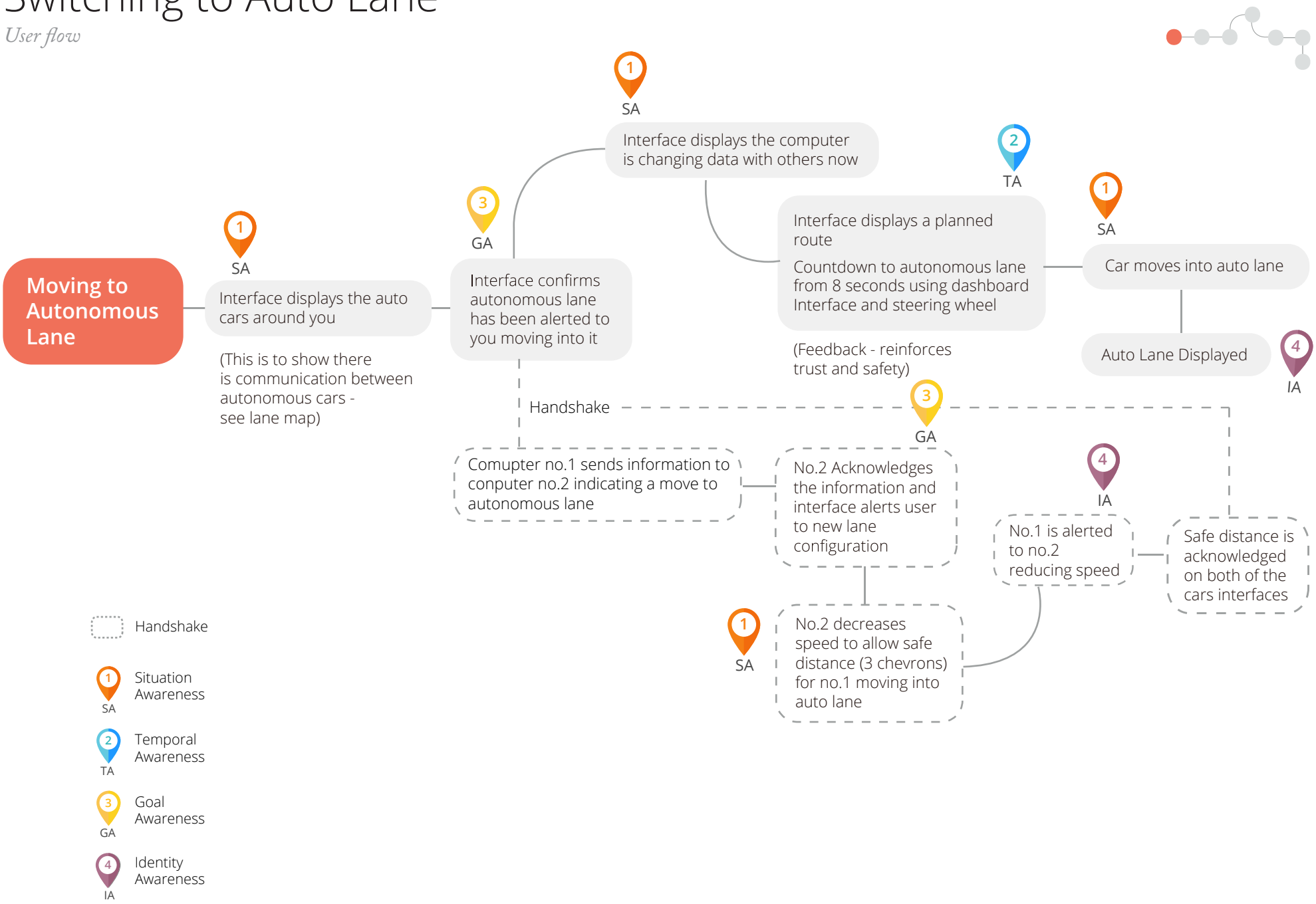
All Interfaces consistent and displaying that auto mode is on

The main colour of interfaces has changed to blue. This help the driver to immediately understand the difference between the auto and manual mode and specifically, what mode the car is in.



Switching to Auto Lane

User flow



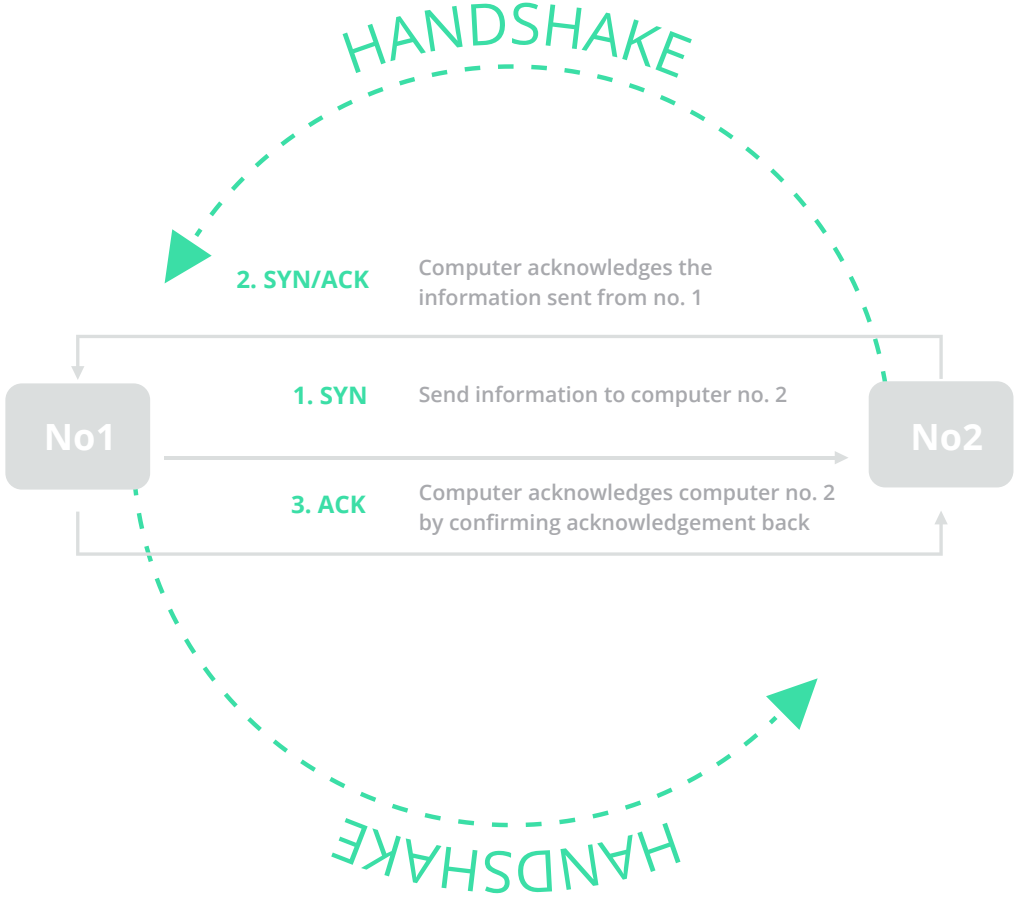
Handshake Principle

How do other drivers users communicate through their interfaces

The process of a 'Handshake' between two computer systems is the sharing of critical information and how it is communicated. This outlines where and at what stage critical information needs to be read by both computer systems and translated through their respective UI's.

The importance in showing the handshake is to establish user trust in the system and that the user(s) know everything is operating optimally in the system.

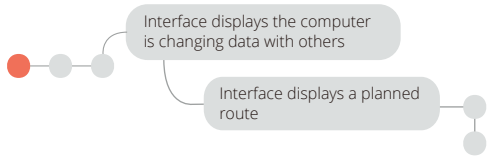
The handshake principle was used in our designs and made clear to drivers on their interfaces by way of 'car symbols'. We found that by using cars allowed the drivers to relate to real-term objects over something more technical. This encouraged consistency and mapping.



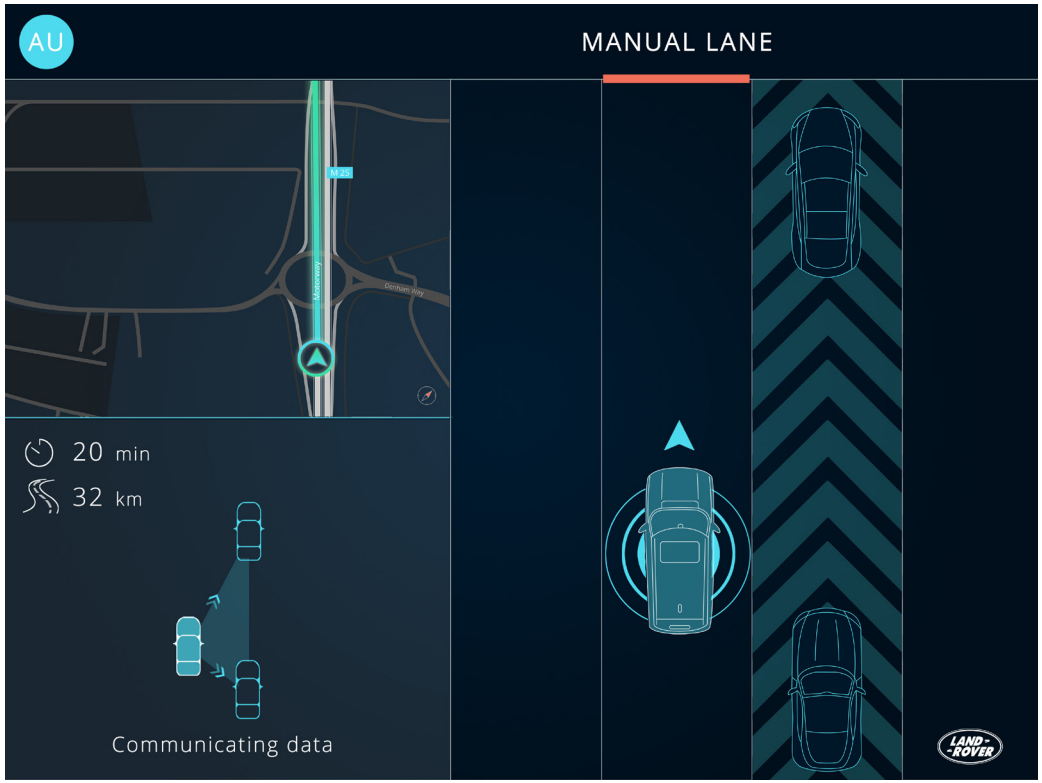
Key
SYN - Synchronise
ACK - Acknowledge

Mapping

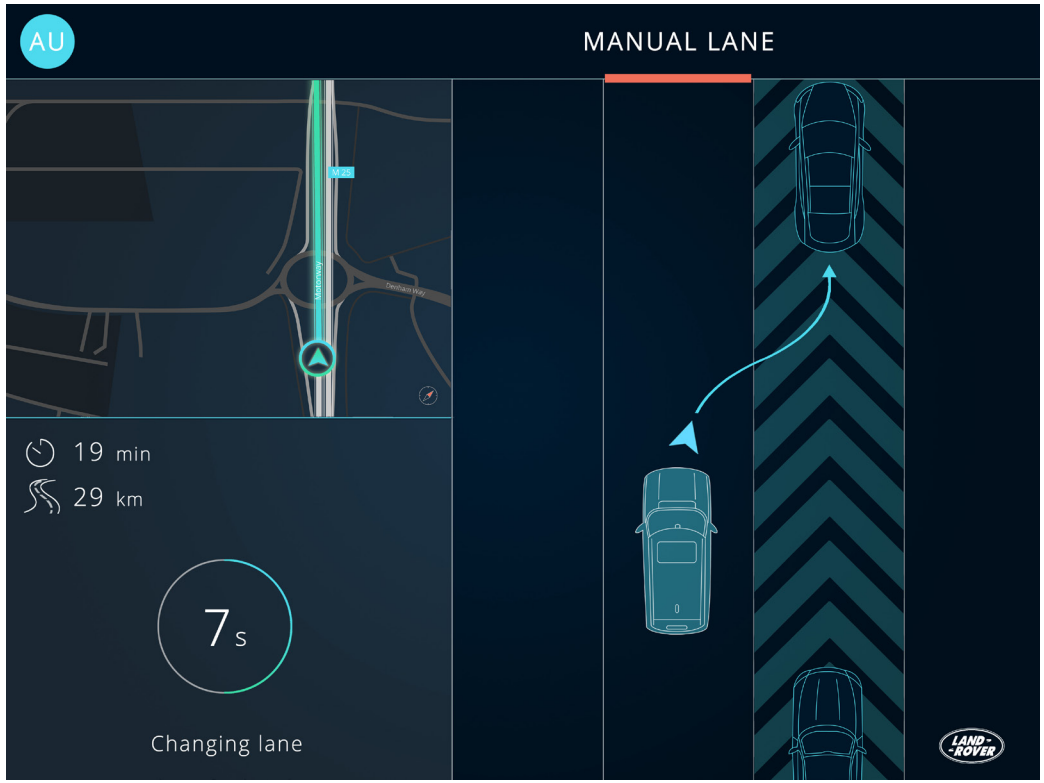
Design principle



Visualising the handshake between multiple vehicles by providing a direct correlation between the car patterns and real world objects. This helps the driver understand what is happening and/or what is about to happen.



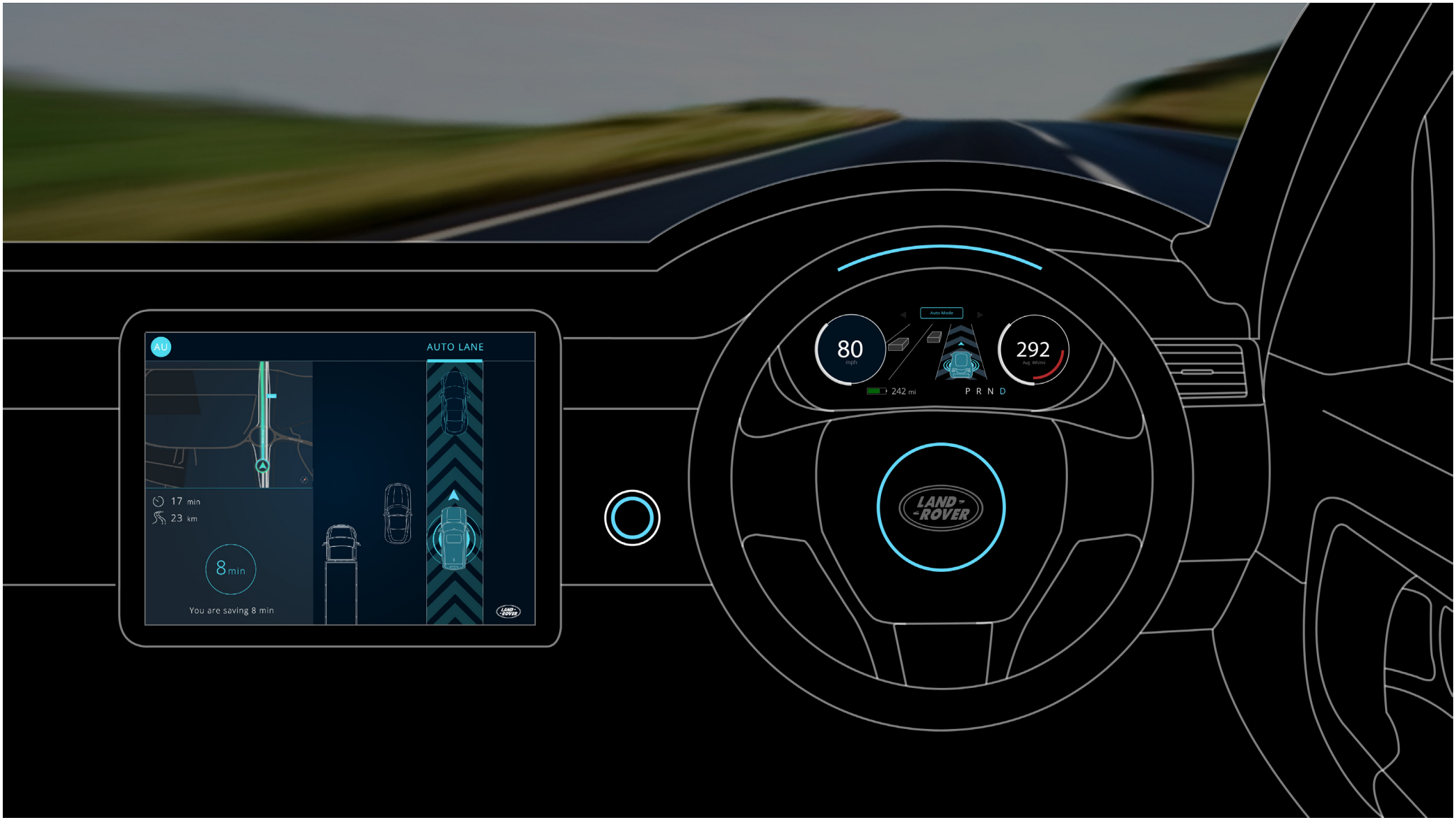
The interface shows that the car is communicating data with other auto cars.



The interface shows that the car is changing lane follows the planned route.

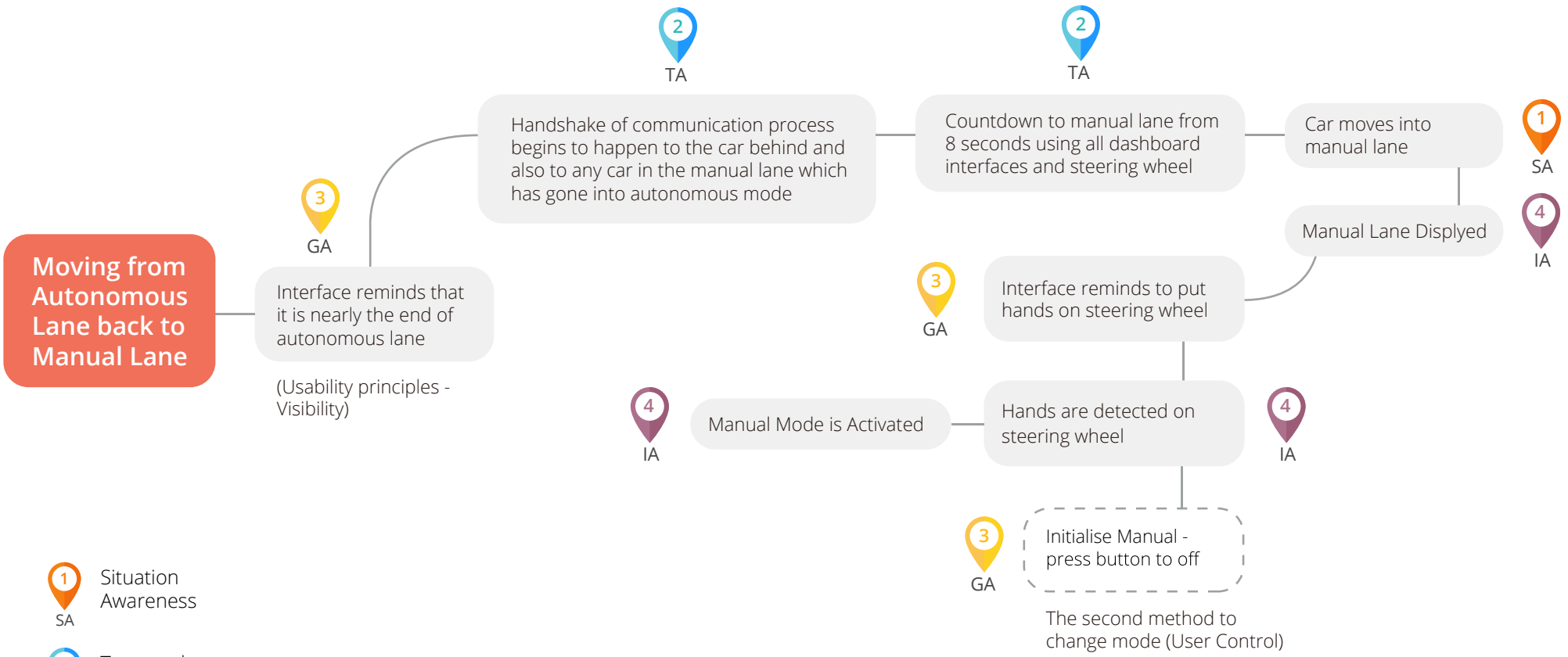
Auto Lane Displayed

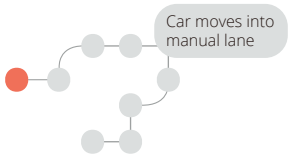
The car is now being driven in the auto lane. Both UI's show the same and only critical information.

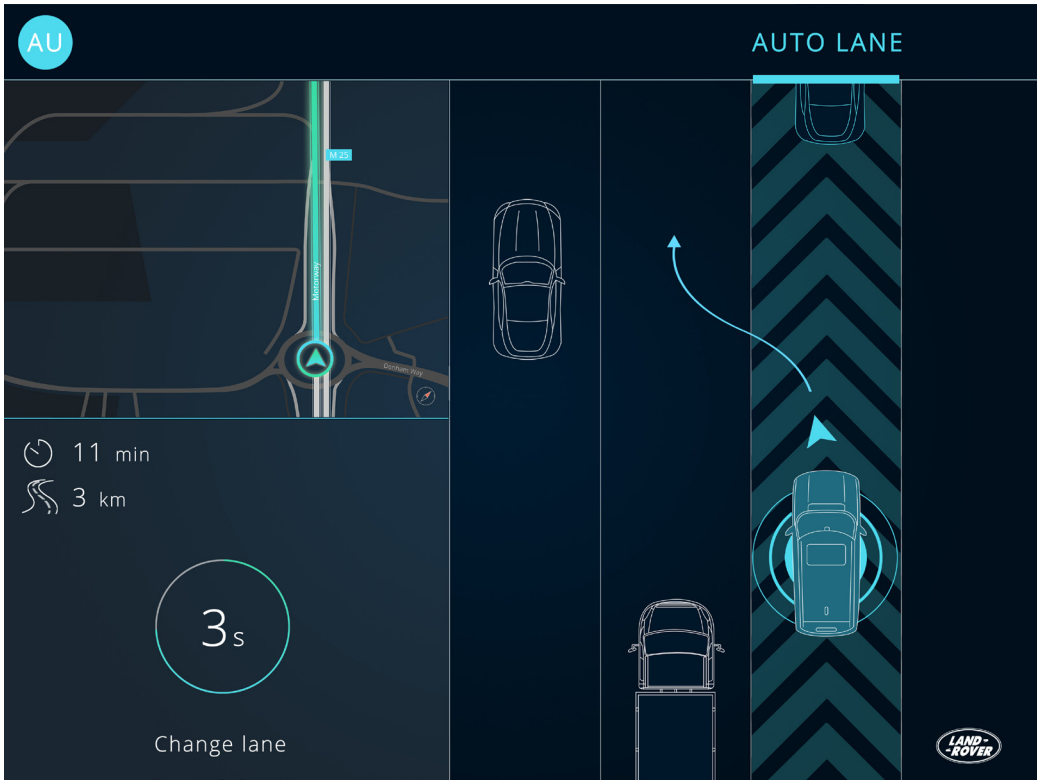


Moving back to Manual Mode

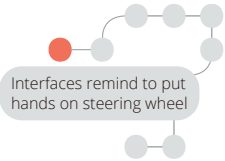
User flow

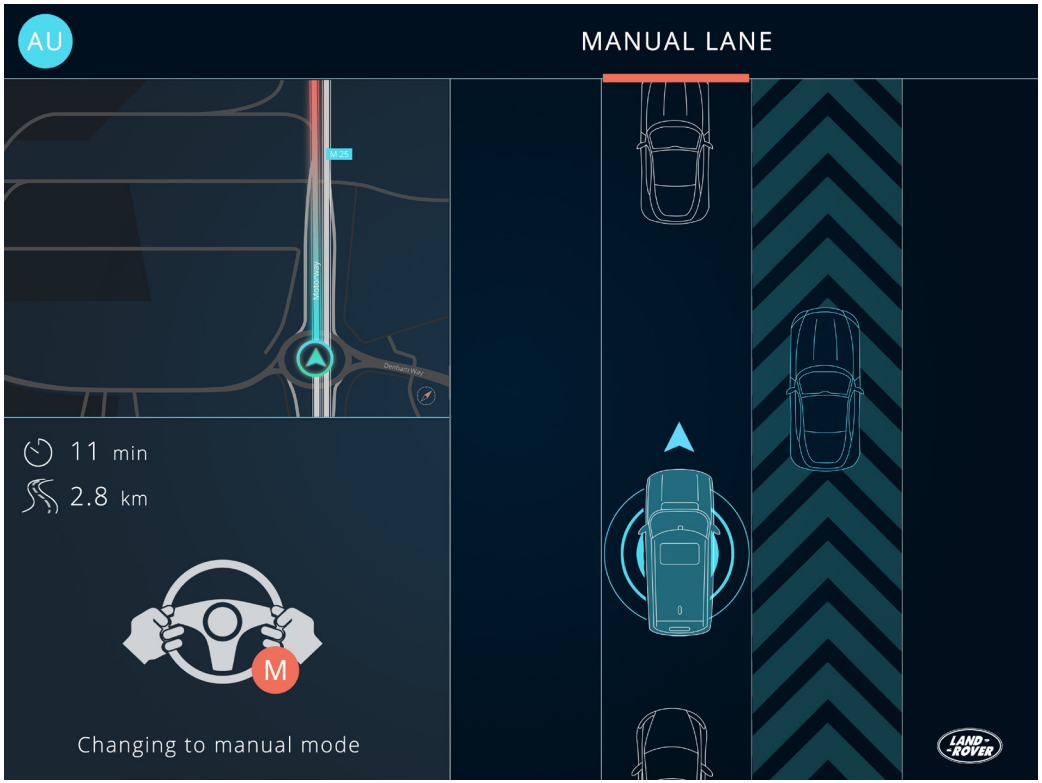






The countdown system and the planned route are shown on the interface when changing lane. The car is moving to the manual lane with auto mode.

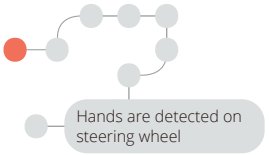




After changing to the manual lane, the interface will remind the driver to change to manual mode automatically.

User Control

Design principle



From user research, we found that being able to take back control at any given stage is key to feeling safe in an auto vehicle. Considering the flexibility, there are two ways to change mode. Firstly , users are able to change to manual mode by holding the steering wheel with both hands, so the move to manual can be sensory. Secondly this could be done by pressing the physical button to change mode.

Conclusion

To sum up ...

In order to show the level of detail that was involved in every interaction, whether that be a system UI or user need via a system UI, we had to be strict on how far we took the concept. Taking advice from our client, we decided that the best approach would be to only think of the critical detail involved in each situation. By doing so it enabled us to be very conscious of creating an experience which would feel human and importantly real to the user.

As we became focussed on detail over a more aesthetic designed UI, we felt that we had captured what a user would want from a L3 - L4 in today's year. We didn't get too involved in the futuristic tech images our secondary research had highlighted but instead used those for inspiration and produced a design which captured user needs and addressed concerns.

We identified our own obstacles in doing so. When being passive and looking at our final design through less experienced eyes, we knew that many obvious concerns would be raised. We would be asked "what is this happens?", or "what do you do in this situation, if this happens?" In order to be thorough on the detail we had to be objective in our own designs and only design for what we needed.

The scope of this project could be very big and by identifying our own limitations early on in this process, helped us to have our own set of guidelines to stay within. This was a useful exercise as a group and something we had to refer back to many times so we didn't lose sight of the approach we had set ourselves in the earlier stages.

After 12 weeks working on this project we felt that we addressed the client's considerations, overcame our own steep learning curve into autonomous driving and the various levels within that and produced a final narrative and concept which defined our approach and vision clearly.

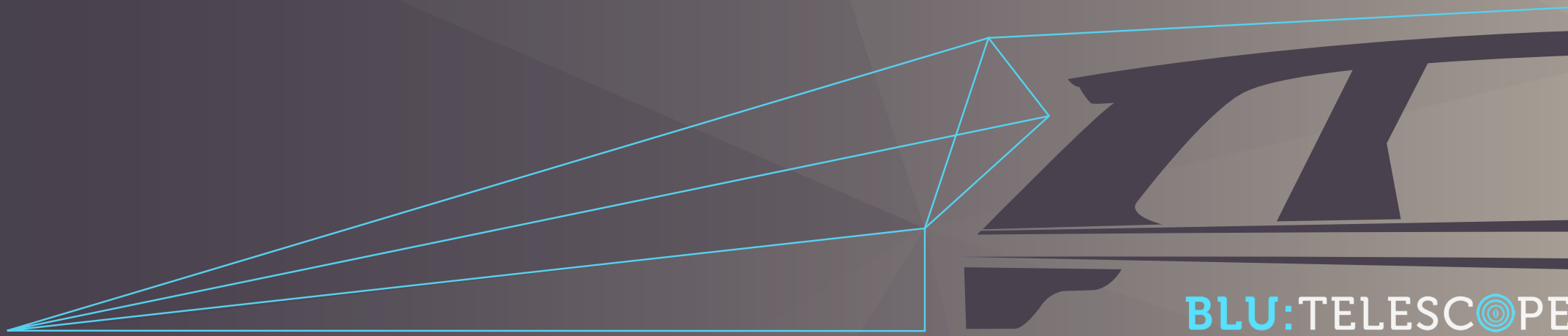
We have identified our 'next steps' to this project, if we were to have more time allowed and to continue working on it. These would be to test our concept in real terms. We would propose to user test in a car, using an ipad or similar device for the UI. Paper and scaled up prototypes would still be helpful here as we could identify how a user responds to the interface within a cabin environment. We would like to test for visibility issues, whether the right critical information,

is in fact as useful and critical as what our designs have highlighted. We would analyse our reflection on heuristics within our designs and see if they are achieving what we set out to do. Finally, not only having a user test in a car but also, whilst driving the car - this would be the crucial and important user test we could hope to do in the next stages.

We would also like to develop our scenario further, looking at where there is scope to address some of the aforementioned considerations of 'what if this happens, how would the car respond to this?'

This is a very exciting time for the automotive industry and over the next 15 years we will see some interesting and no doubt in current times some inconceivable things happen as cars move into from L2 to L3 and into the L4 space.

We hope that Blu:Telescope in many ways touched upon some of the user needs that fit into these areas and we look forward to seeing what lies ahead.



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