



The Self Learning Car

Nvidia GTC

Nick Black – Chief Product Officer

April 2016

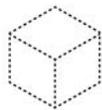


Piecing Together The Puzzle

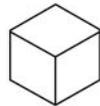
CloudMade Learning Solutions



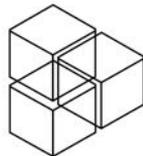
Professional Services



Design



Development



Systems Integration

Partner Ecosystem





Automotive First



Juha Christensen
Chairman & CEO



Nick Black
CPO



James Brown
CTO



Pavel Stelmakh
Program Management



Jean-Marc Matteini
Product Planning

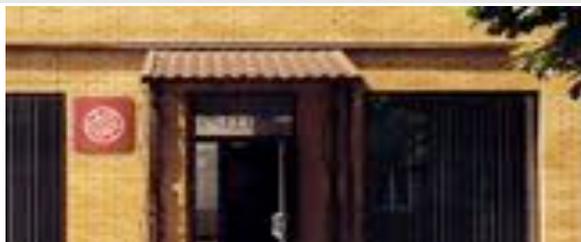


Taras Bublyk
Product Management

Management Team Past Successes:



Kyiv R&D:



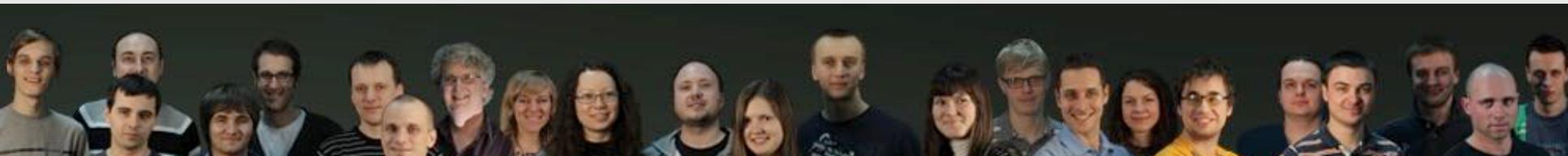
Munich Design Studio:



CloudMade Fleet:



Engineering & Design Team:





The Most Personal Experience

CloudMade's solutions enable personalized, adaptive user experiences across all car domains:

The HMI



The Cabin



The Ride





The Self Learning Car – A Mountain To Climb

**Shifting
Business
Models**

**High
Consumer
Expectations**

**A Unique
Electronics
Architecture**

**Interfaces
Designed for
Disconnected
World**

**The
“Sometimes
Connected”
Car**



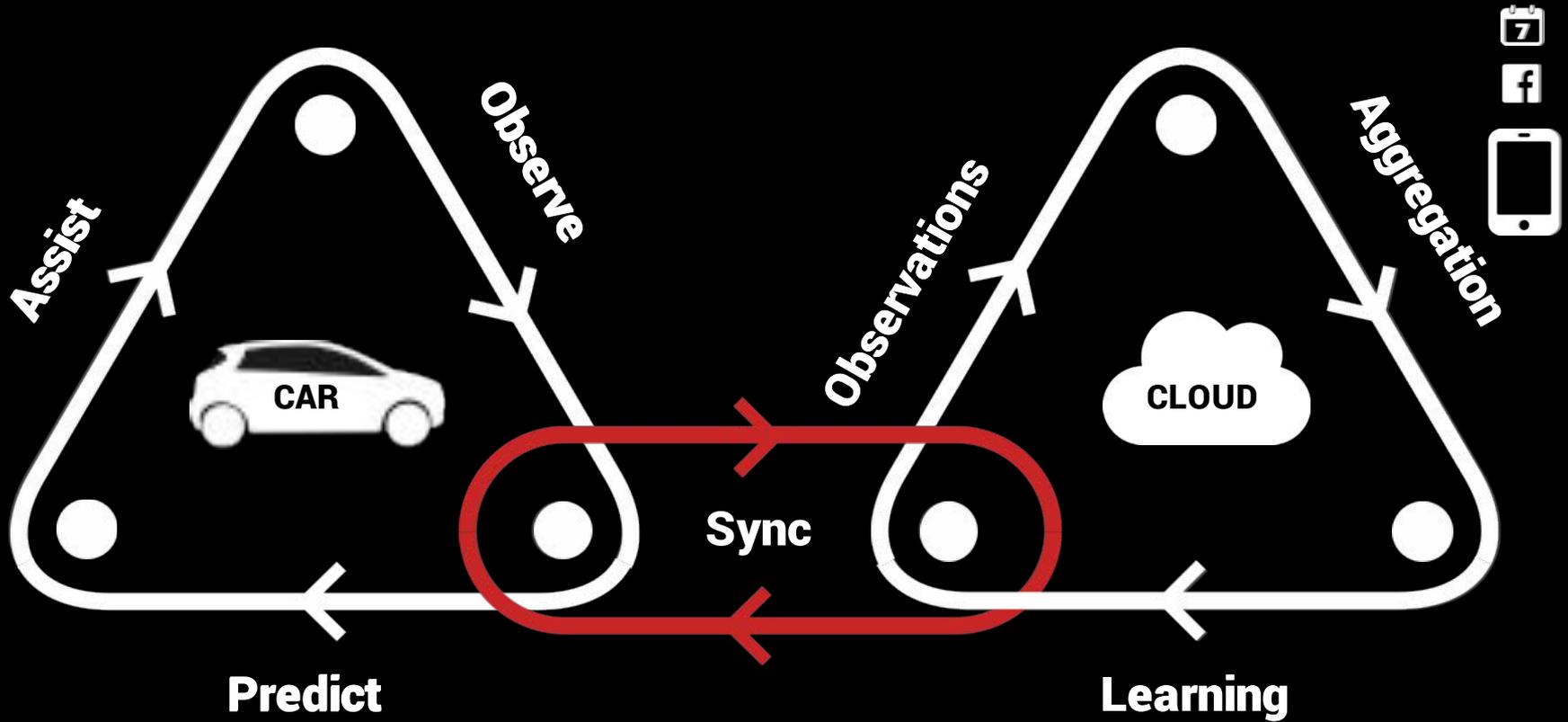


Problem: The “Sometimes Connected Car”

Solution: Distributed Cloud-Car Learning

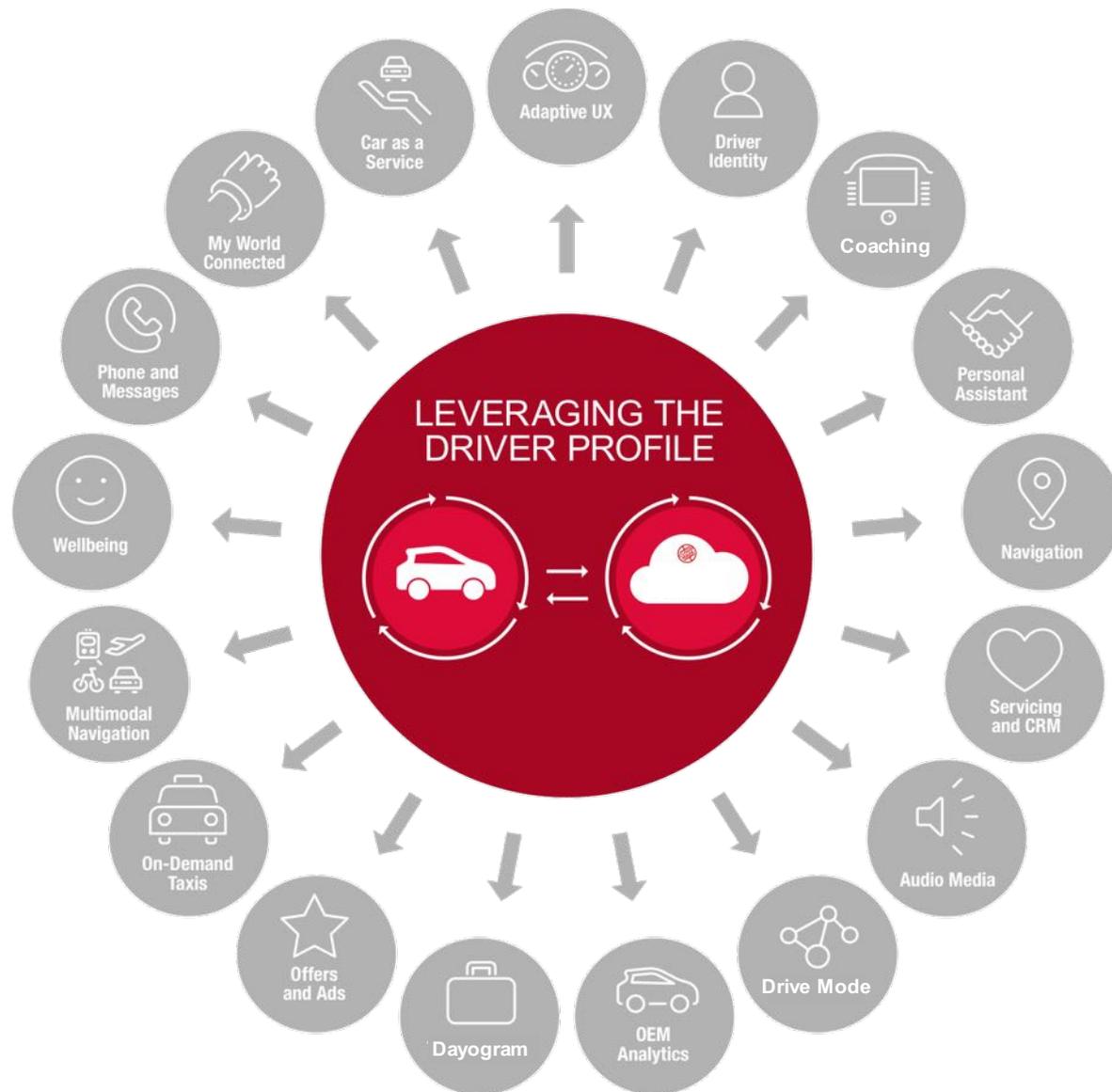


How CloudMade Predicts Future Behavior





One Profile Enables All Use Cases





**Problem: Interfaces Were Designed
For A Disconnected World**

Solution: Adaptive UX



System predicts that driver is about to enter the auto route.



On the auto route the system predicts that the driver will exit in 12.6 miles

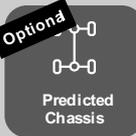


The driver no longer needs a navigation system, the UI changes to show useful features that she often uses whilst on the auto route like her phone call list and media player.

The Holy Grail of Car Interfaces

By wiring all of these modules together, you get to a user interface which is complete adaptive to the driver and passengers' needs.

12 Inference engines for "Adaptive UI" Usecases:

 Optional Predicted Occupant ID	 Predicted Travel Goals	 Predicted Controls	 Predicted Call List	 Optional Predicted Place Affinity	 Optional Predicted Driving Mode
 Predicted Routes + Destinations	 Optional Predicted Driver Behavior	 Optional Predicted Chassis	 Predicted Cabin	 Optional Predicted Parking	 Optional Predicted Trip Affinity

Adaptive Cabin



Expected driver
Julia



Seat position
Upright



Seat heating
Warm



Cabin lighting
Wake-up



Ventilation
Off

The cabin is perfectly configured for the respective driver.

By knowing driver's cabin preferences (e.g. seat settings, heating and cooling, mirror settings, etc) the car helps to customize it for each journey. The Predicted Cabin modules builds upon information learned such as the driver's behavior, their likely departure time, etc to deliver a holistic experience.

7 Inference engines required for "Self Learning Cabin" Usecases:



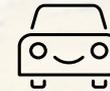
Adaptive Chassis



Seats
Active



Steering
Sporty



Car autonomy
Minimum

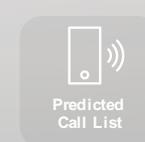


Suspension
Stiff

A personal pit crew waiting to tune the car

By connecting all of the knowledge so far to the car's chassis systems, the car is able to customize the feel of the drive via components like suspension, braking, steering etc, to give a completely personalized ride. The Predicted Chassis module uses and builds upon the information learned by modules like Predictive Routes and Destinations.

Five Inference engines for "Adaptive Chassis" use case:

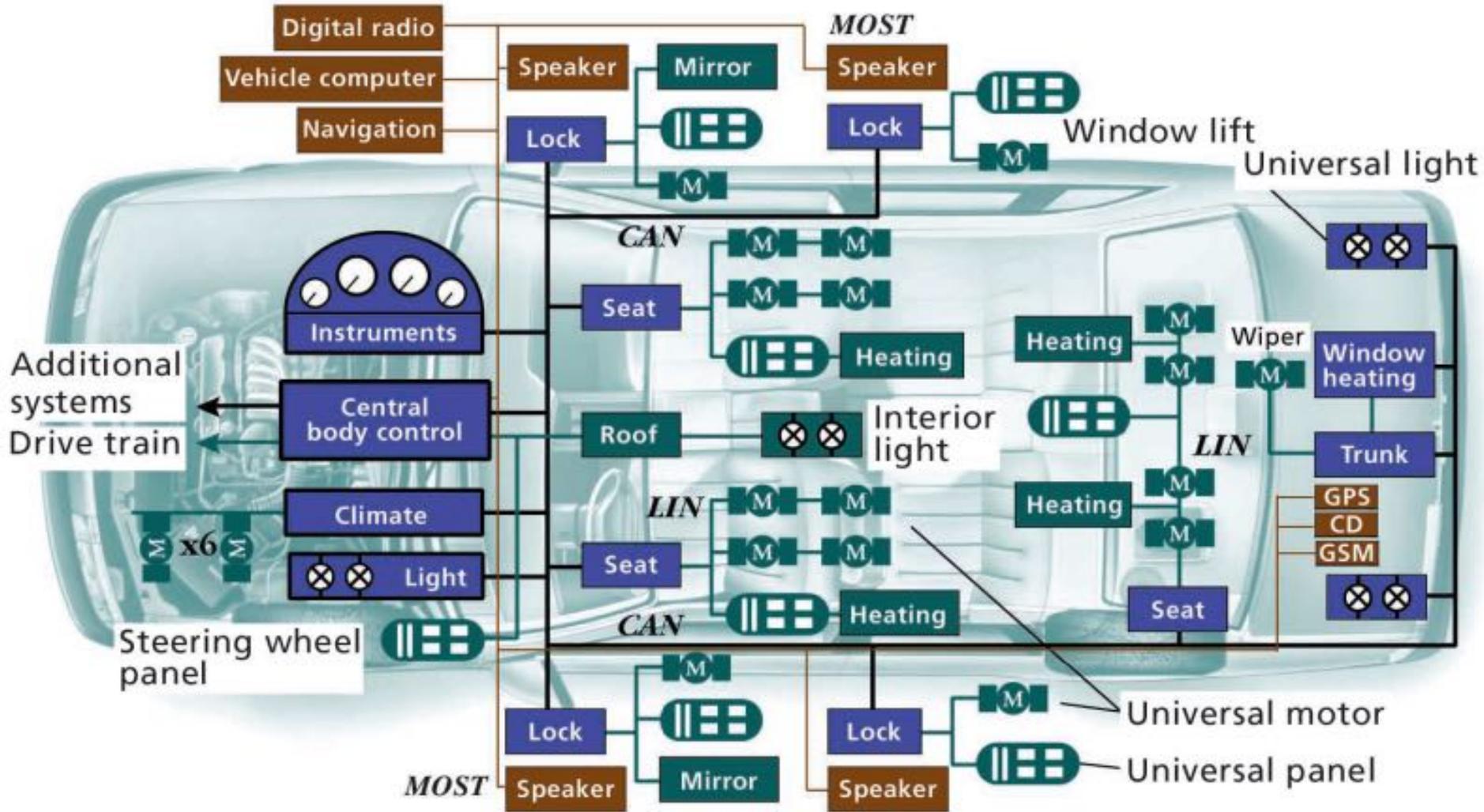




**Problem: Cars Have Unique
Electronics Architectures**

**Solution: Designed From The Ground
Up For Automotive**

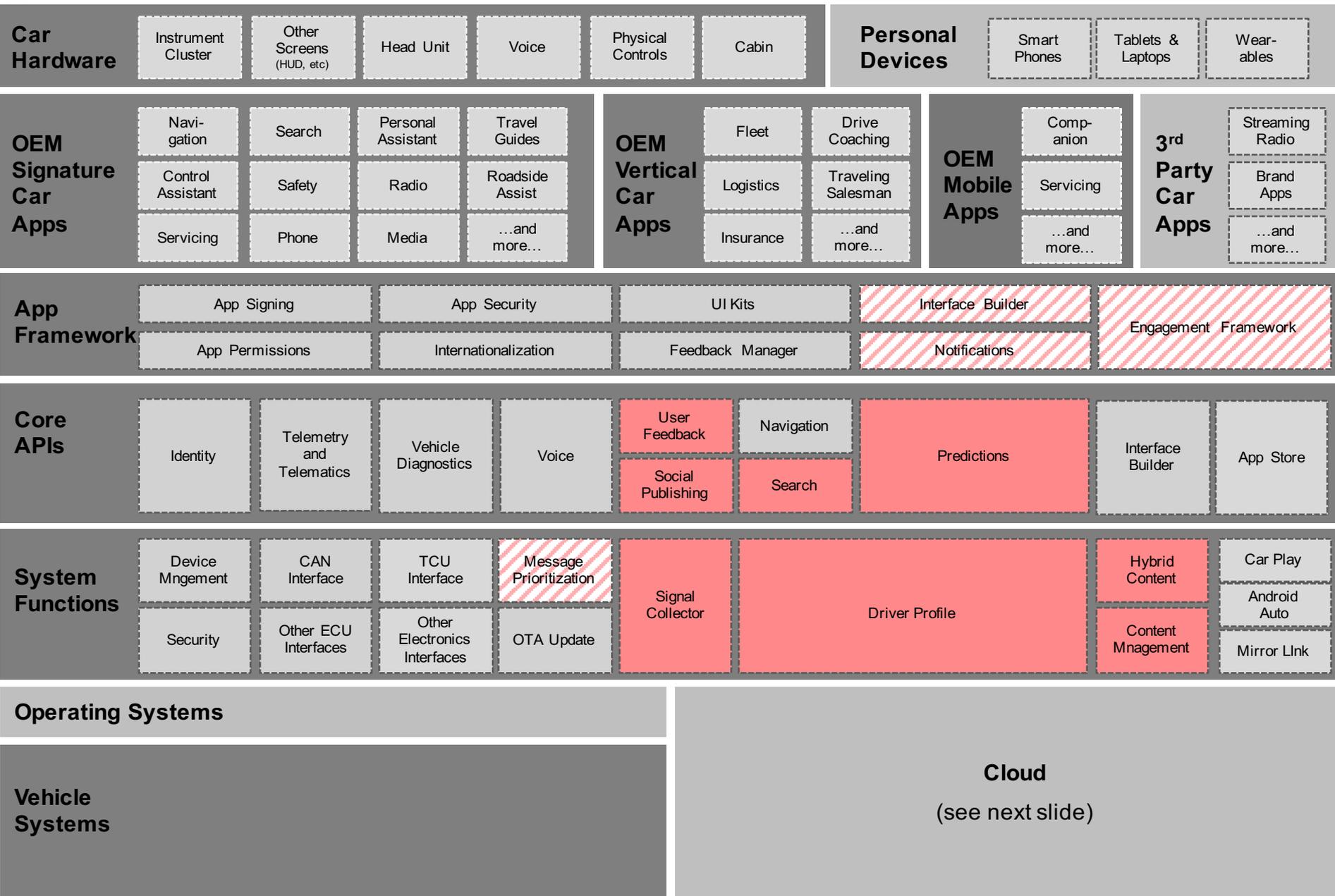
A Complex Architecture With No Single Abstraction Point



- CAN Controller area network
- GPS Global Positioning System
- GSM Global System for Mobile Communications
- LIN Local interconnect network
- MOST Media-oriented systems transport



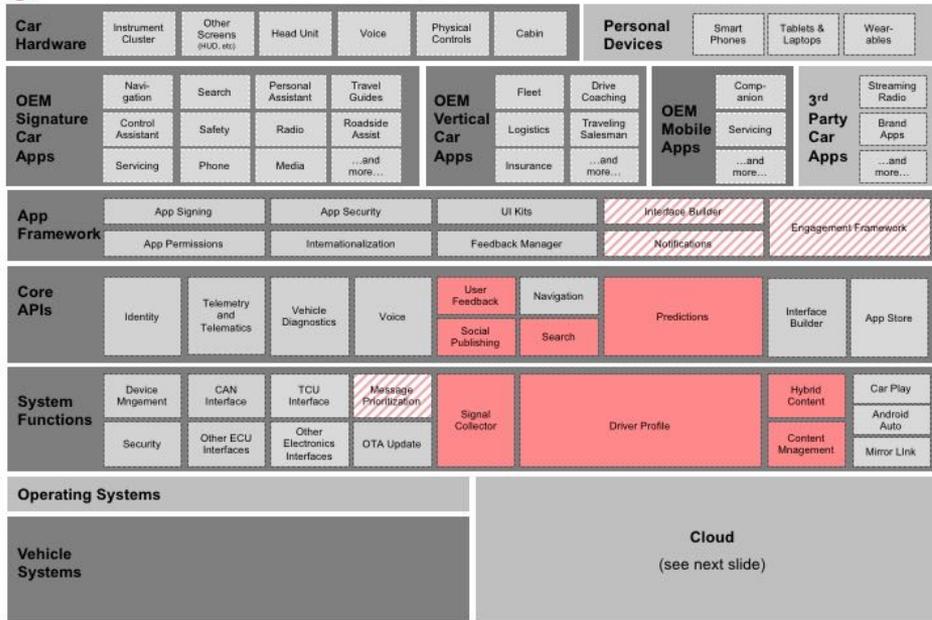
A Flexible Architecture For Multiple Automotive Use Cases





One Size Doesn't Fit All

A Flexible Architecture For Multiple Automotive Use Cases



All of the following deployment models are in use today at CloudMade:

1. Natively onto the infotainment system (e.g. Linux or QNX).
2. As an app onto the infotainment system.
3. Onto the Telematics Control Unit
4. Onto an existing ECU (e.g. seating controller)
5. Onto a specific “CloudMade ECU”



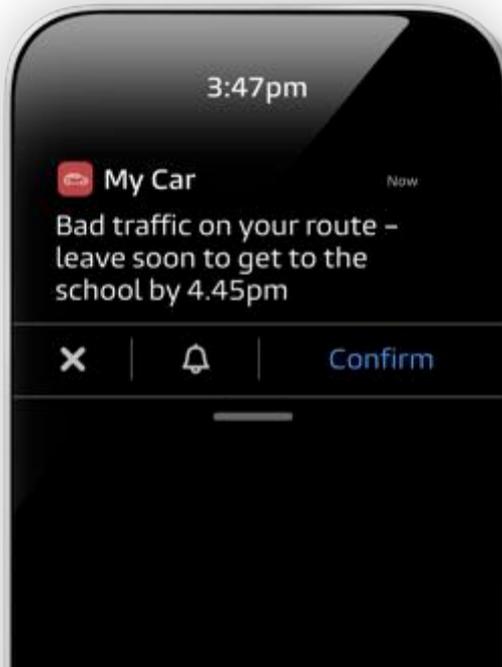
Problem: Consumers Have High Expectations

Solution: Expertise In Consumer Behavior and Rigorous Analytics
Proof Points



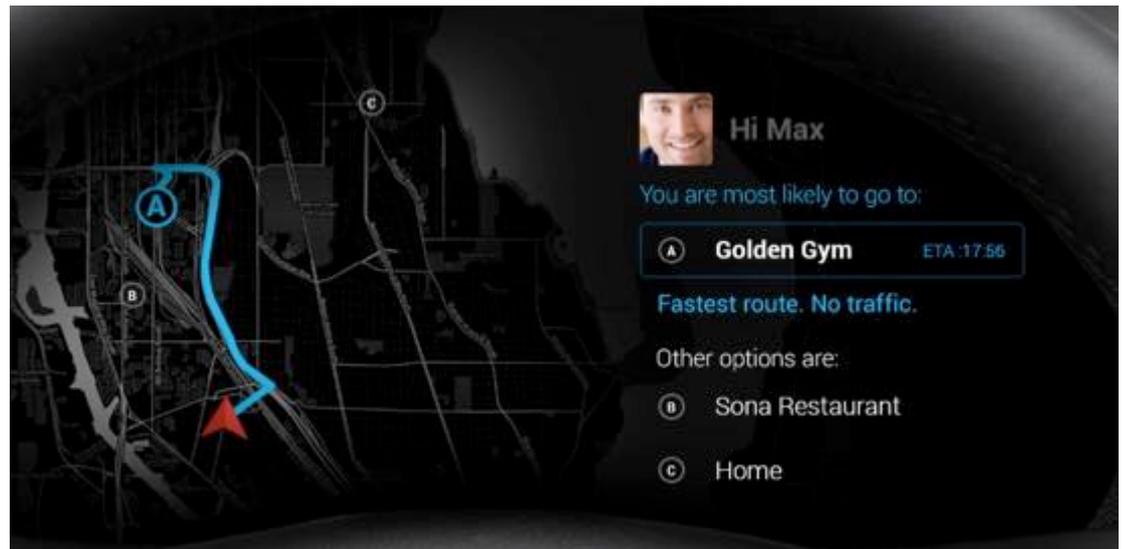
Predictions Are Use Case Specific

Push Mode – whenever the user is interrupted by a prediction or when the driver is focused on another task (making the prediction secondary to the current task) a predictive system needs to deliver only predictions that it is very confident in. In this specific example the determination is that it is better that the system not deliver a notification to a driver than risk sending them an incorrect notification.



A typical predictive navigation use case is predicting the next destination a driver will visit. In this use case a system needs to understand the context of the message in order to decide what confidence level to use. Two use cases are shown here.

Pull Mode – when the user is focused on the same context as the prediction (e.g. choosing a destination to navigate to) a predictive system needs to deliver maximum coverage. In this example the determination is that it is better for the system to occasionally show a destination that user isn't going to visit than to show nothing at all. It doesn't cost the user additional effort to not use the prediction shown.





Rigorous Analytical Proof Points

Proof Points Demonstrate Quality Of Learning

- CloudMade has extensive sets of “proof points” produced by a rigorous process to validate the performance of an inference engine (learning module).
- We are ready to engage in a deeper discussion about the algorithms we use for learning and the results they generate.
- We would welcome the opportunity to take your experts through a deeper dive into our learning proof points and algorithms.

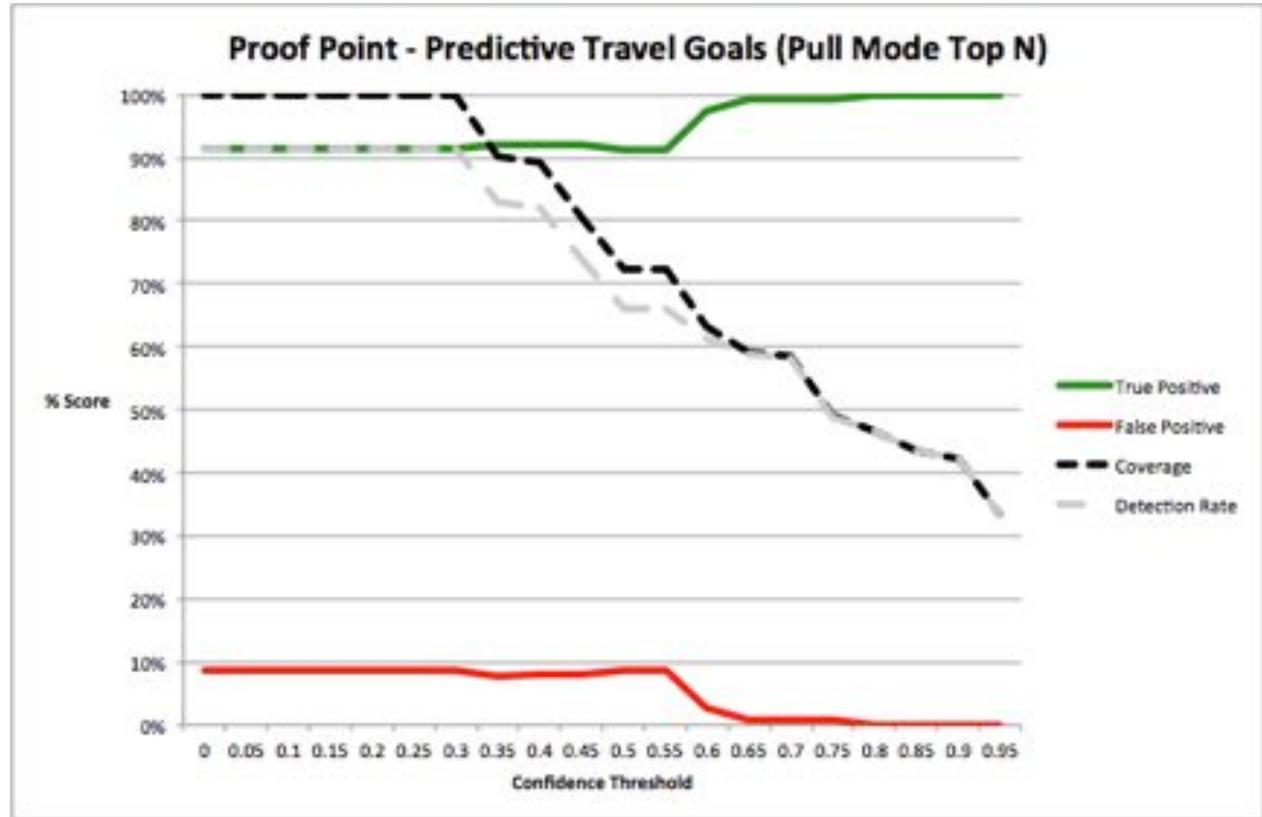


Chart shows how the true positive rate for one module – Predictive Travel Goals - (the green line) can be tuned using the “confidence threshold” to deliver results that fit the use case.

Think of the “confidence threshold” (horizontal axis) as being a dial that can be tuned to impact the results shown. Sometimes it is appropriate for the HMI to deliver results with a lower confidence level, sometimes a higher level is required.

Coverage and detection rate are compared to the full sample set rather than the theoretical maximum (sample less inherent variability) which is not shown.

A high threshold (e.g. 0.9) means that the Smart Data system will deliver very few “false positives”. This is the right setting for a “push” use case that may interrupt the user with predicted information.

Conversely, a use case such as displaying 3 likely predictions on the dashboard is less sensitive to errors, so setting a lower confidence threshold (e.g. 0.6) will yield a fuller set of results.



Problem: Shifting Business Models

**Solution: OEMs Use CloudMade's
Solutions To Build Lifelong Loyalty
Amongst Their Customers**



Max, 18 years



Eating and Drinking

Purchased Content

Linked Drivers and Family

Entertainment

Predicted Destinations

Medical Records

Driving and Route Style

Friends and Social Style

Safety Preferences





Max, 22 years



Eating and Drinking

Purchased Content

Linked Drivers and Family



Predicted Destinations

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Safety Preferences

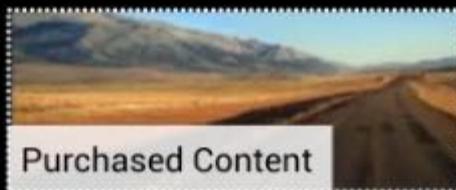




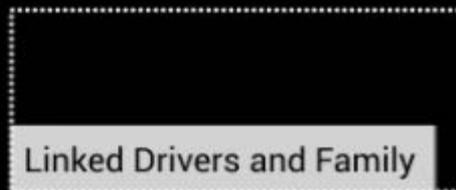
Max, 27 years



Eating and Drinking



Purchased Content



Linked Drivers and Family



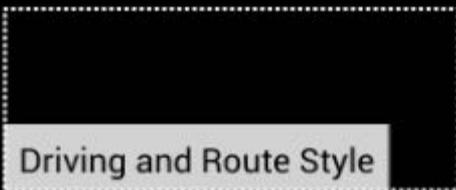
Entertainment



Predicted Destinations



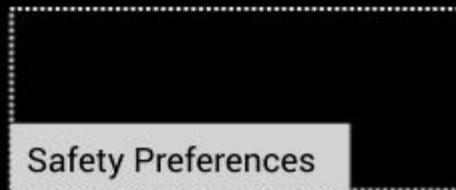
Medical Records



Driving and Route Style



Friends and Social Style



Safety Preferences



- Where would you like to go:

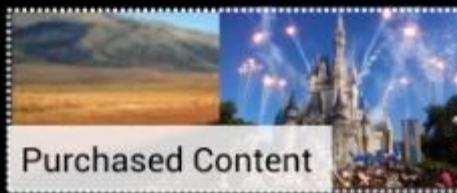
- 1 Home ETA: 7:48 AM
- 2 Starbucks ETA 7:13 AM
- ▶ Enter destination



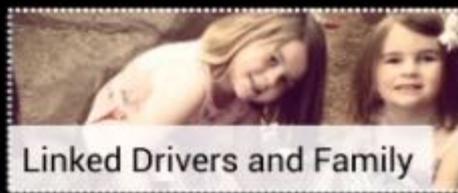
Max, 35 years



Eating and Drinking



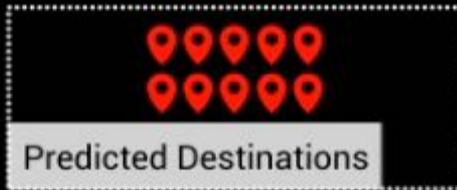
Purchased Content



Linked Drivers and Family



Entertainment



Predicted Destinations



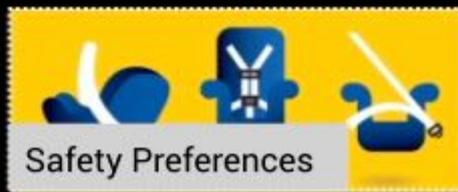
Medical Records



Driving and Route Style



Friends and Social Style



Safety Preferences

Dear Max!
We are happy to invite You
to test drive our newest SUV



Max, 46 years




Eating and Drinking

BLUE RIDGE
WINE EXCURSIONS

Purchased Content



Linked Drivers and Family

CLASSICAL MASTERS
LIBRARY



Entertainment



Predicted Destinations



Medical Records



Driving and Route Style



Friends and Social Style



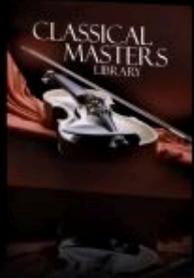
Safety Preferences

Selected: Scenic Route

Car settings



- Suspension:
 - ▶ Performance
- Transmission:
 - ▶ Sport





Max, 87 years



Eating and Drinking



BLUE RIDGE
WINE EXCURSIONS

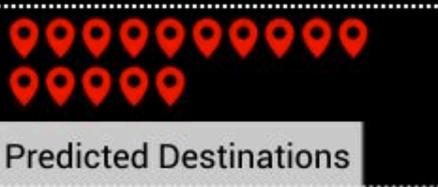
Purchased Content



Linked Drivers and Family



Entertainment



Predicted Destinations



Medical Records



Driving and Route Style



Friends and Social Style



Safety Preferences



28 /100
MILES / HOUR





Connected Car Solutions

Self Learning Car



Adaptive UI

POC

Gives the car the ability to anticipate the needs of the driver, letting the UI offer functionality to the driver and passengers as needed based on their profiles, their past behavior and the context of the drive.



Comfort & Assistance

POC

Offer comfort and assistance features like cabin pre-conditioning, personalized heating and cooling, assisted onboarding of ADAS features like ACC, learning cabin settings like seating and mirror positions.



Navigation

Production

Offer in-car navigation experiences that are superior to smartphone competitors by offering drivers predicted destinations and journeys, a choice of personal routes like safest, least stressful and access to rich content like parking and POIs.



Communication

Design

Connect drivers and passengers with their friends and families in a safe and engaging way. Features like predictive call list make phone use in the car safer, Dayogram lets drivers share their journeys with their social networks.



Global Content

Production

Global content like POIs, weather data, gas prices, etc. from well local brands that drivers love is made available to OEMs and Tier 1s to integrate into their search and infotainment products.



Entertainment

Design

Offer in-car entertainment experiences that learn the preferences and habits of the driver and their passengers to make selection of entertainment easier, less distracting and more personal for the driver and their passengers.



Personal Assistant

POC

Use powerful machine learning techniques to offer a broad range of "personal assistant" features to drivers and passengers that help busy drivers stay productive, arrive on time and stay safe, happy and healthy through their driving lifetimes.



Coach & Performance

POC

Offer drivers applications that help them master their driving skills, become better, safer or more confident drivers. All drivers - from novices, to parents with teen driver to performance enthusiasts can benefit.

Mobility & Fleet



Mobility Services

POC

A range of compelling mobility services targeted at drivers, passengers, public transport users, traditional fleets (e.g. hire cars), new fleets (e.g. on-demand taxis) that put the OEM in control of the future of mobility.



Fleet

POC

Gives OEMs a range of well differentiated services to offer to fleet customers like rental car companies and large, medium or small enterprises.

EVs



EVs

Design

EV drivers demand specialist features to help them get the most out of their cars and help to reduce range anxiety. Features like EV route planning, up to date EV charging station maps and EV focused drive coaching apps help EV drivers.

CRM and Analytics



Remote Analytics

Production

The only automotive specific analytics solution that lets OEMs and Tier 1s extract CAN data from their vehicles into a server side big data environment, allowing for over the air updates to specific signal collection and collection rules.



CRM

Design

A range of features that help OEMs and Dealers sell more cars and improve customer loyalty, ranging from predictive maintenance to customer car, warranty optimization and management.

Ads and Offers



Ads and Offers

Design

Lets OEMs deploy in-car advertising experiences that monetize the connected car and open the door for new business models. Leverages the driver and passenger profiles to build a detailed understanding of habits, likes and dislikes.

The Self Learning Car Has Arrived



Say Hello



Nick Black

CPO



James Brown

CTO



**Jean-Marc
Matteini**

Product Planning

Find Out More

<http://cloudmade.com>

Get In Touch

nick@cloudmade.com