



CarLab

Framework for Vehicular Data Collection and Processing

Mert D. Pesé, Arun Ganesan and Kang G. Shin

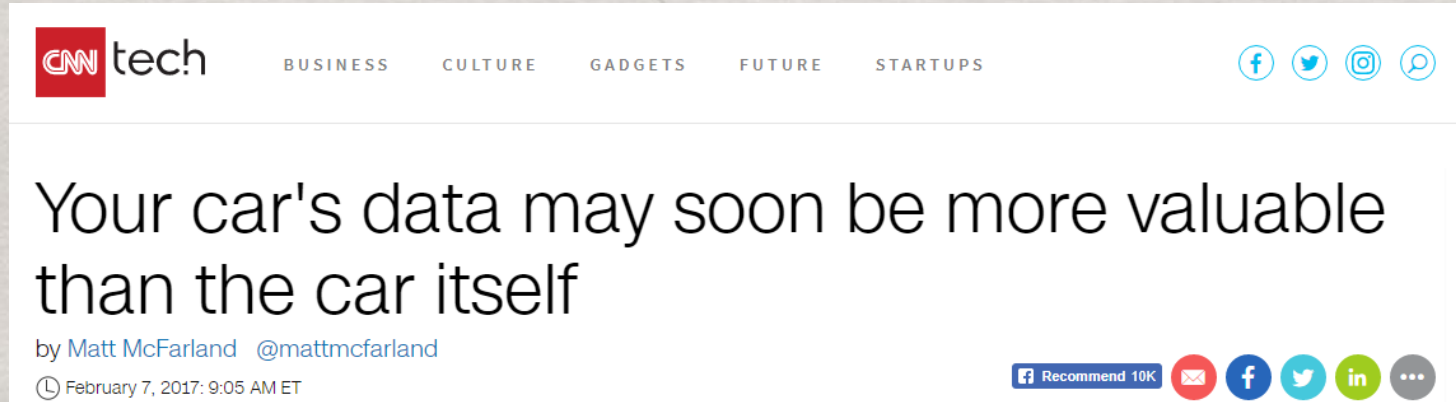
Agenda

- Motivation
- State-of-the-art
- CarLab Architecture
- Research Issues on Data Collection
 - *-aware Data Collection
 - Security and Privacy
- Current Status and Future Plan

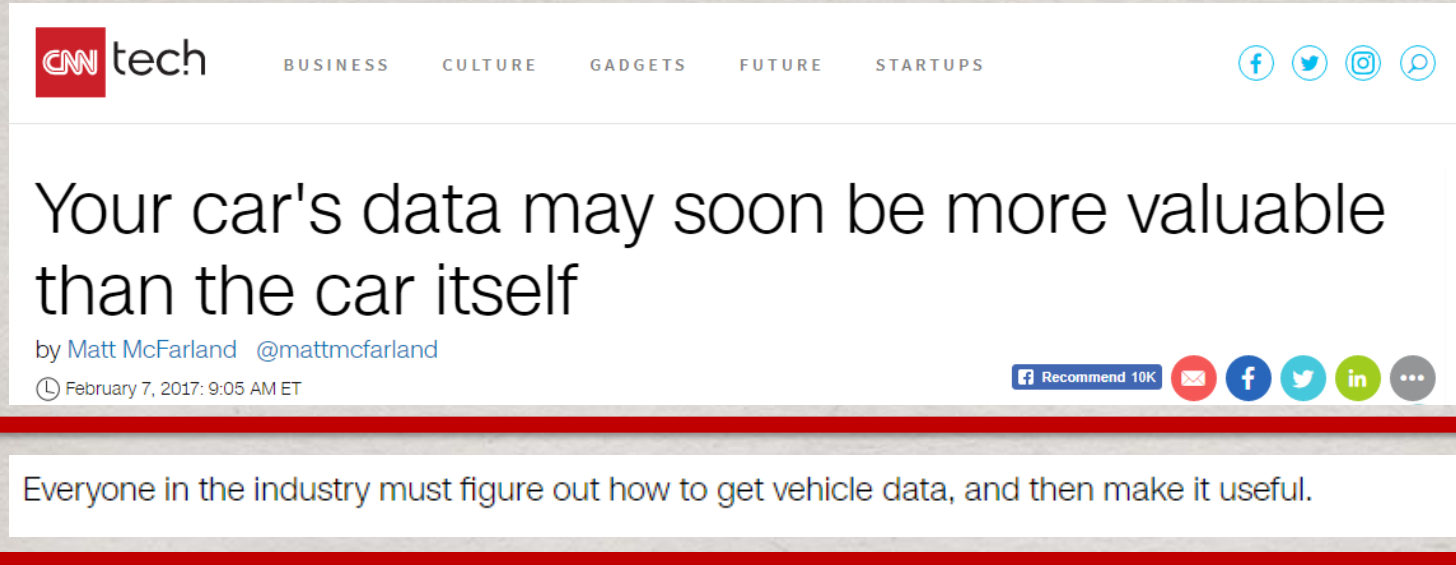


Motivation

- Vehicle-related data is essential for R&D on connected/driverless cars



Motivation



The image is a screenshot of a CNN Tech article. At the top, the CNN Tech logo is on the left, and navigation links for BUSINESS, CULTURE, GADGETS, FUTURE, and STARTUPS are in the center. Social media icons for Facebook, Twitter, Instagram, and a search icon are on the right. The article title is 'Your car's data may soon be more valuable than the car itself'. Below the title, it says 'by Matt McFarland @mattmcfarland' and 'February 7, 2017: 9:05 AM ET'. To the right of the date are buttons for 'Recommend 10K', an email icon, and social media icons for Facebook, Twitter, LinkedIn, and a more options icon. A red rectangular box highlights a quote at the bottom of the article: 'Everyone in the industry must figure out how to get vehicle data, and then make it useful.'

CNN tech

BUSINESS CULTURE GADGETS FUTURE STARTUPS

Facebook Twitter Instagram Search

Your car's data may soon be more valuable than the car itself

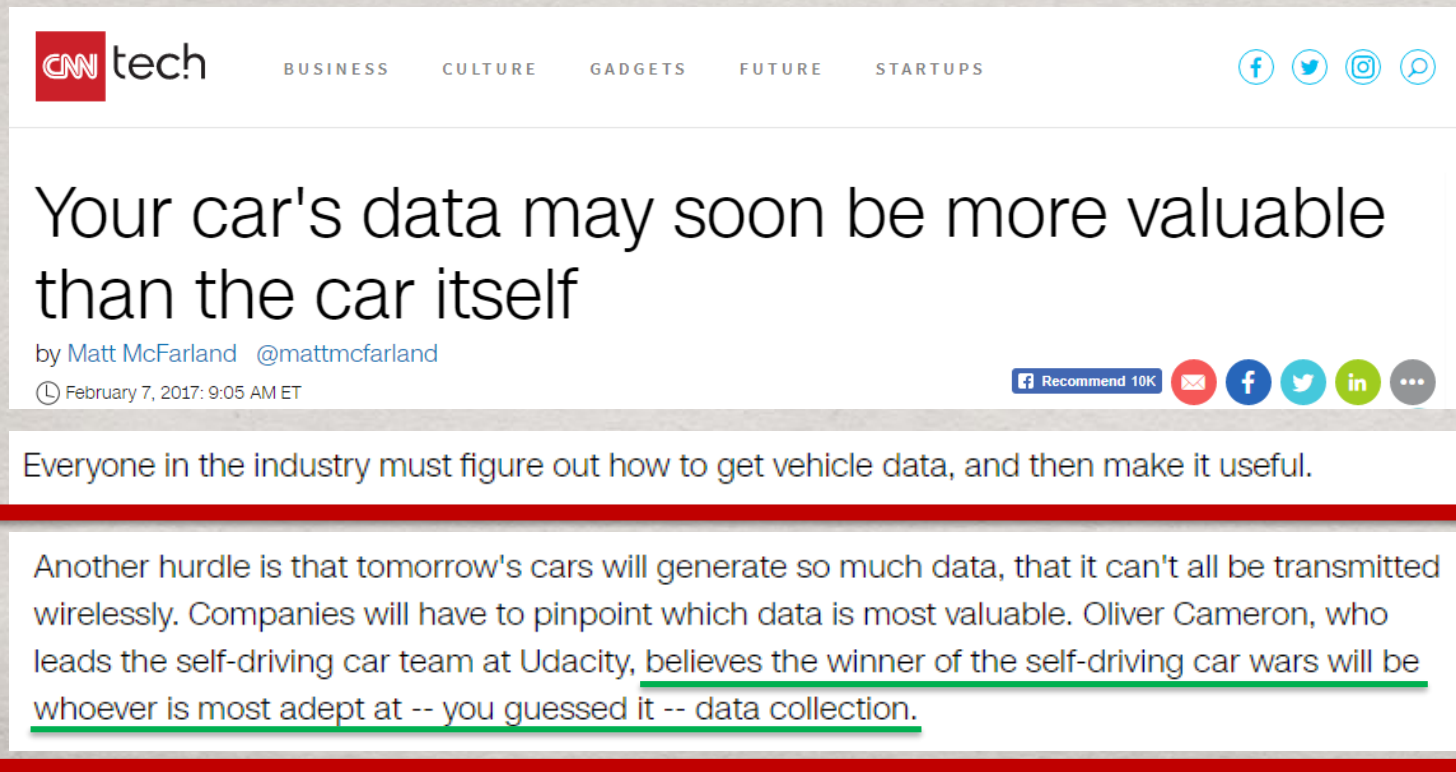
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Motivation

CarLab: Framework for Vehicular Data Collection and Processing



Motivation

CarLab: Framework for Vehicular Data **Collection** and Processing

- **Collection:** From in-vehicle networks, other vehicles/infrastructure using V2X and mobile sensors



Motivation

CarLab: Framework for Vehicular Data **Collection** and **Processing**

- **Collection:** From in-vehicle networks, other vehicles/infrastructure using V2X and mobile sensors
- **Processing:** App Store where developers can submit apps which use a secure and privacy-preserving API

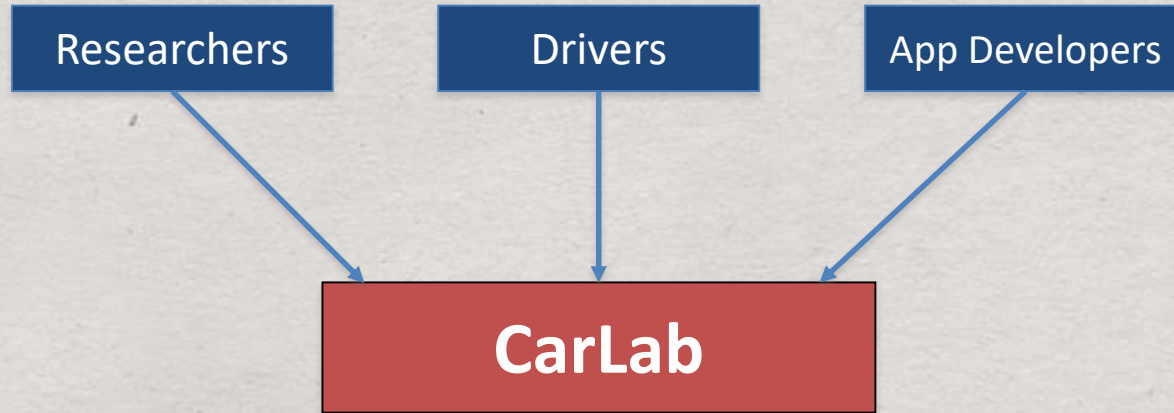


What is CarLab for?

Vehicular research <ul style="list-style-type: none">• Sensor anomaly detection• Driving patterns analysis• Battery state modeling	User-facing applications <ul style="list-style-type: none">• Trip tracking• Teenager geo-fencing• User-based insurance
City-scale research <ul style="list-style-type: none">• Pothole mapping• City-wide traffic modeling• Dynamic weather modeling	Wellness applications <ul style="list-style-type: none">• Heart-rate monitoring• Mental health monitoring• Drunken driving detection



Who are CarLab users?



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State-of-the-art

	Real-Time Network Comm.	Diverse Hardware Support	Flexible Developer API	Secure and Private Data Coll.
Safety Pilot	✓	✓		
IVBSS		✓		
CarTel		✓		
BMW CARDATA	✓		✓	✓
Automatic	✓		✓	
Torque	✓		✓	
CarLab	✓	✓	✓	✓



State-of-the-art

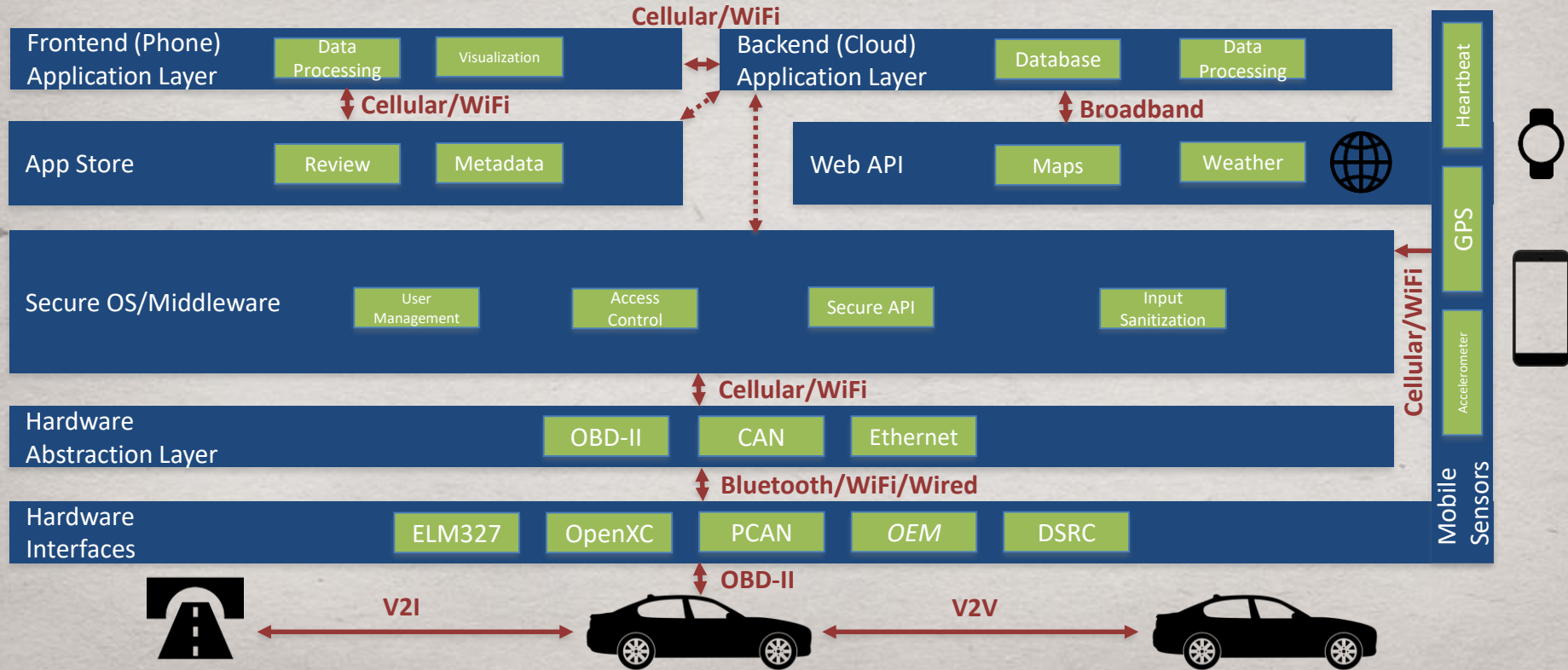
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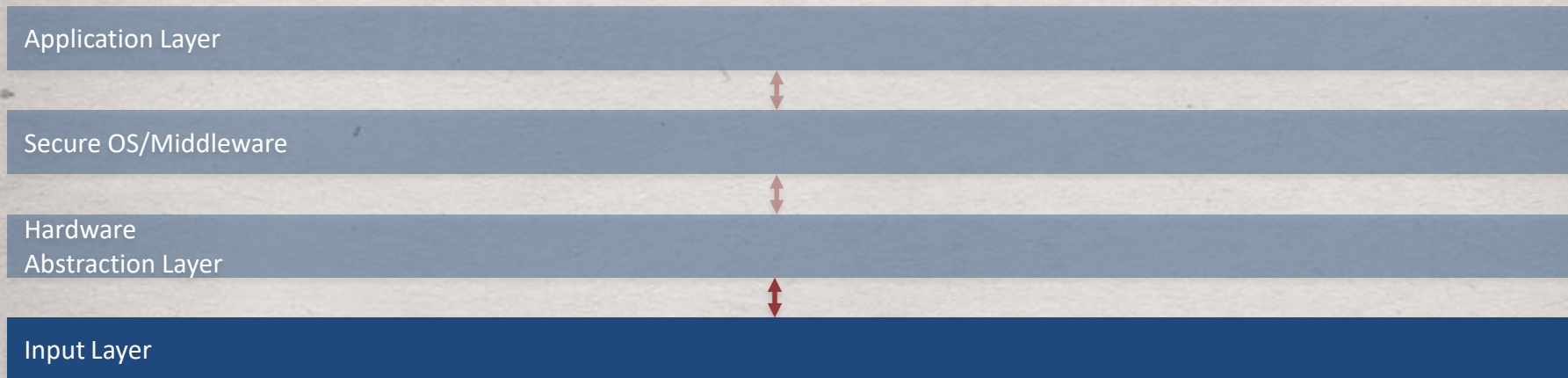
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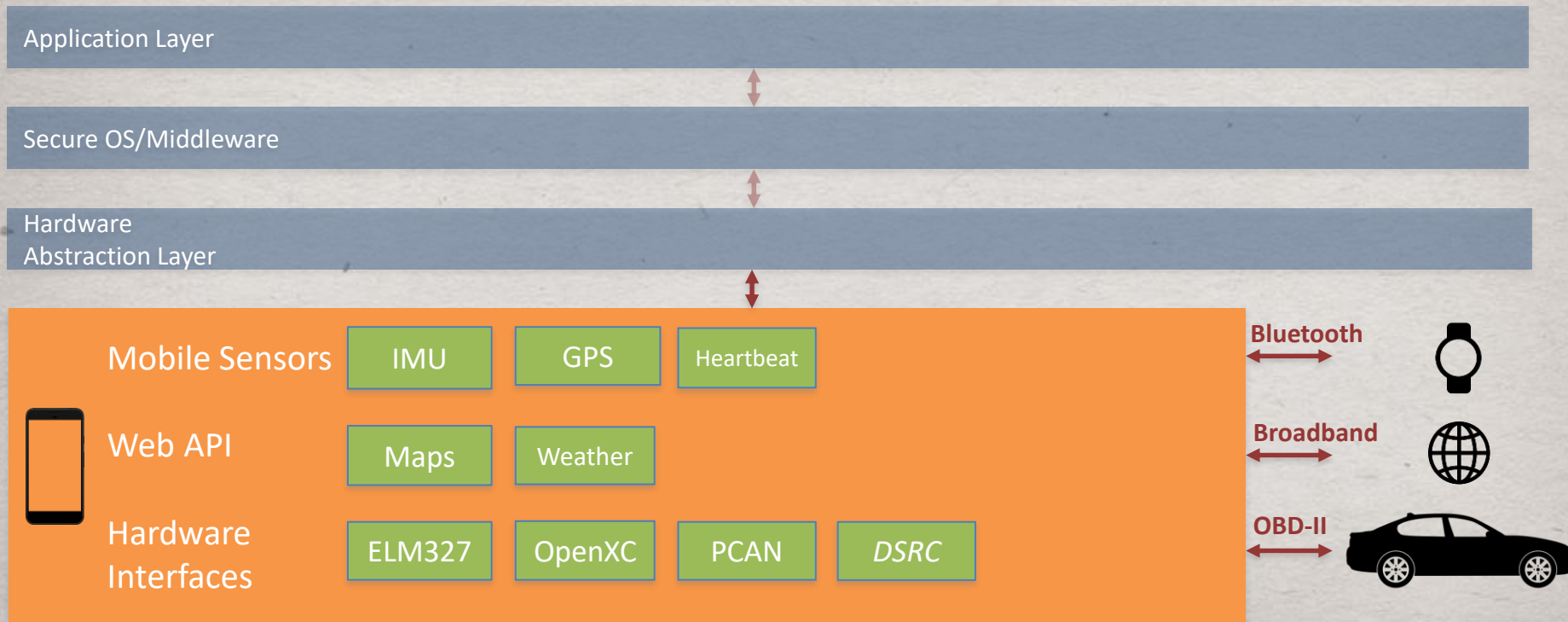
CarLab Architecture



CarLab Architecture



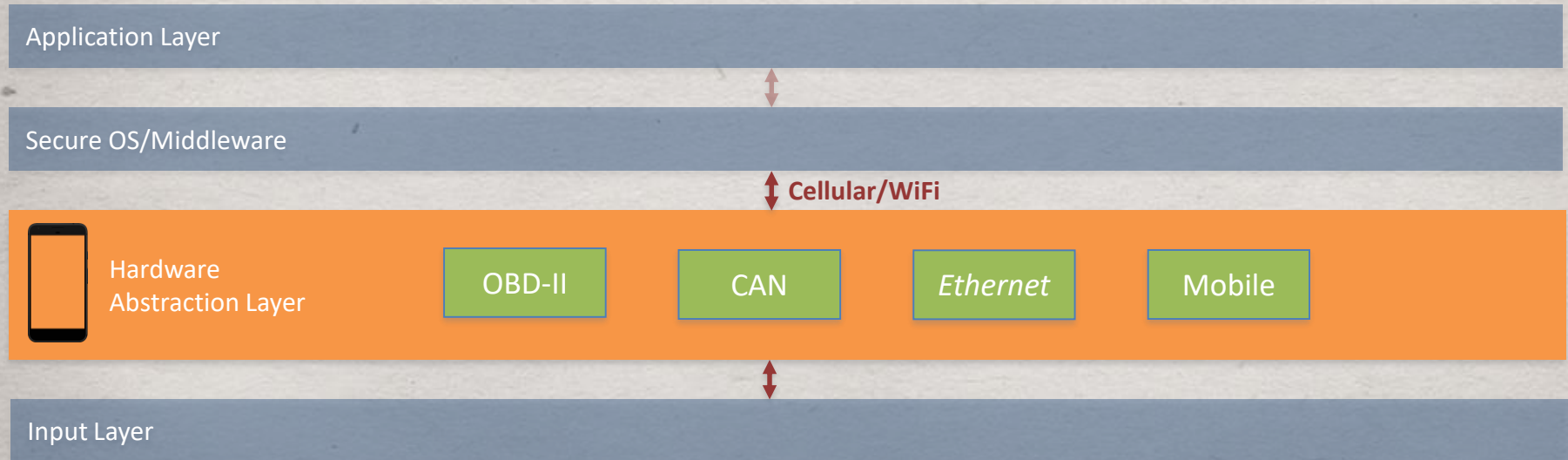
CarLab Architecture



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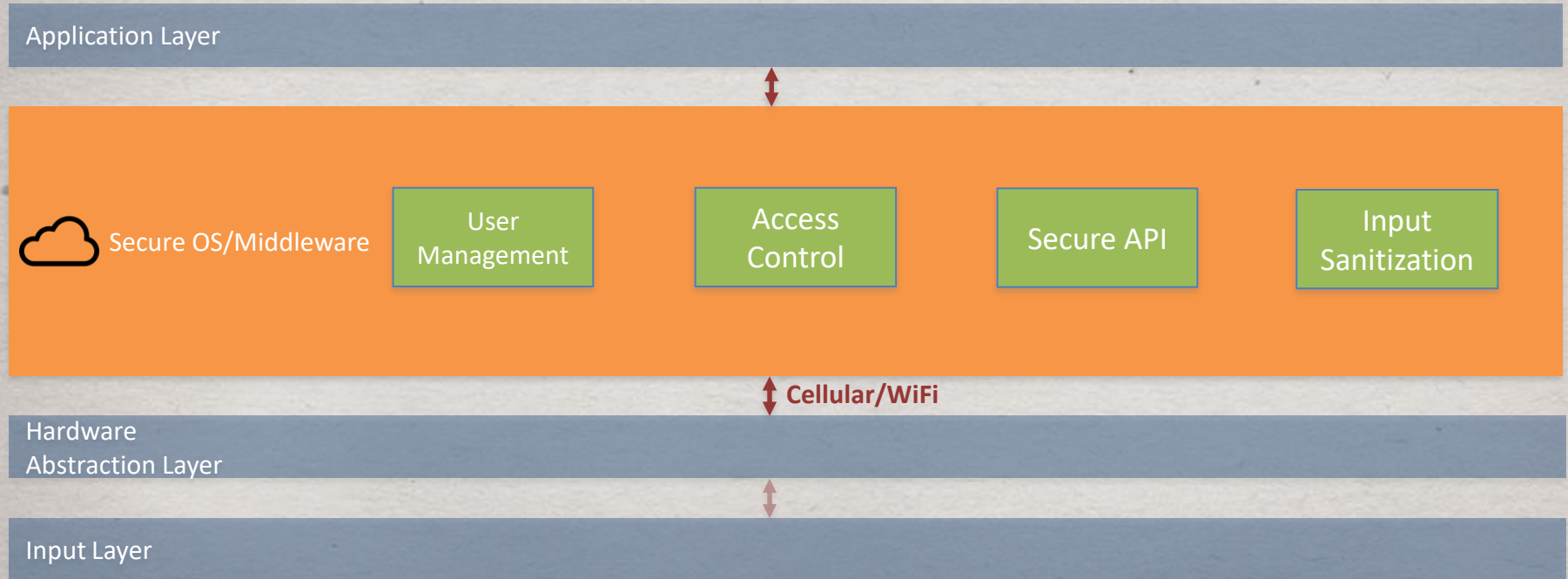
CarLab Architecture



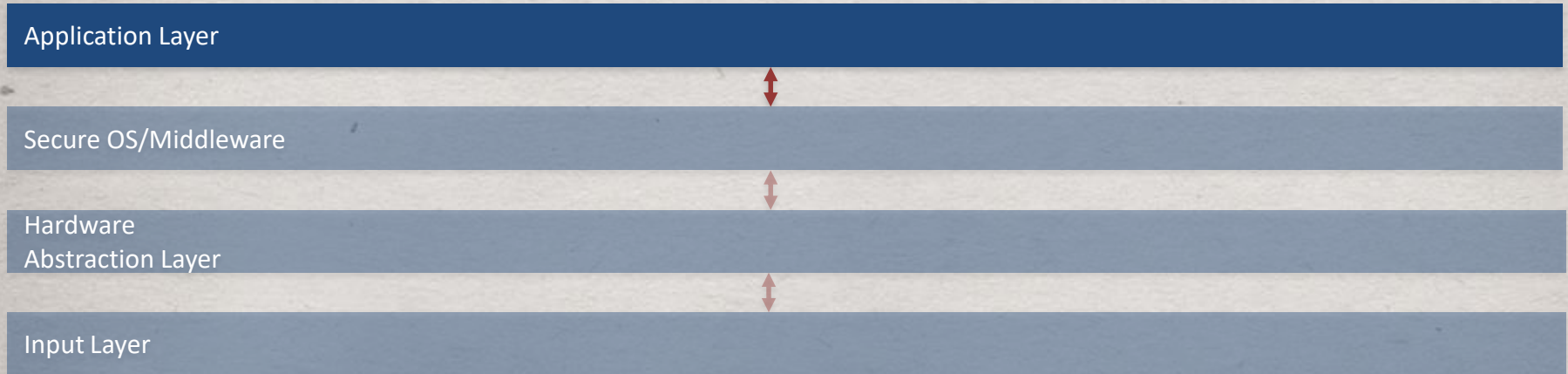
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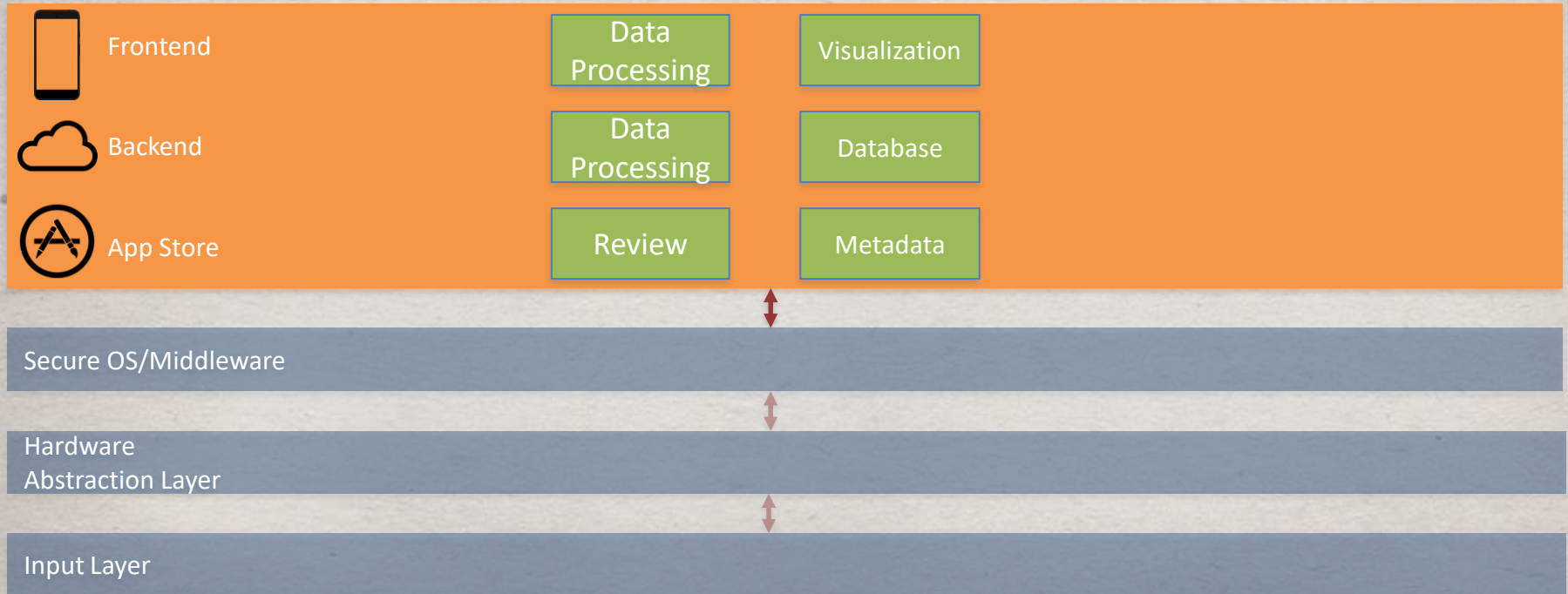
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CarLab Architecture



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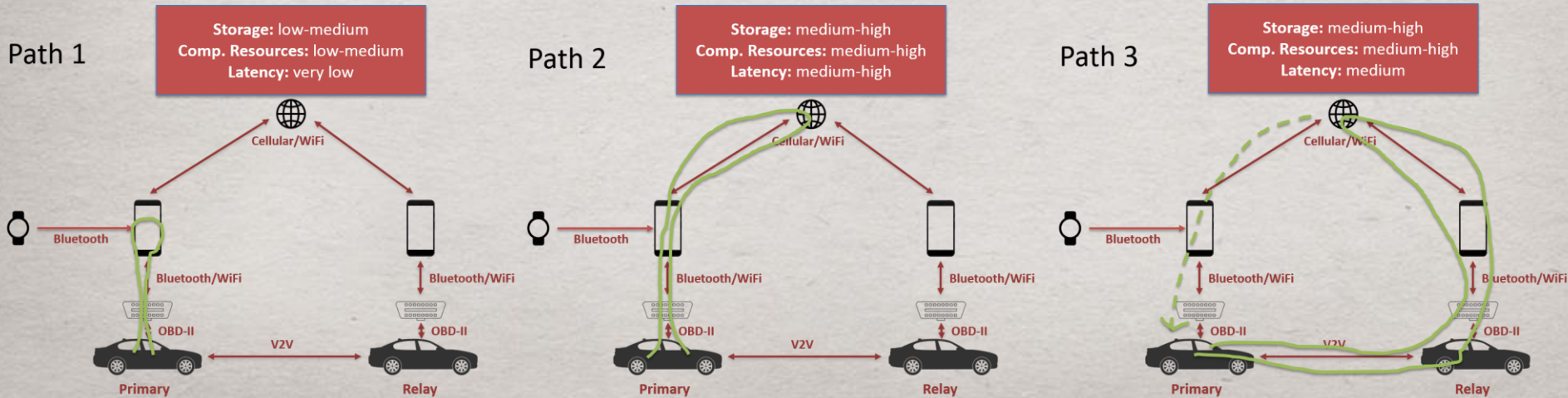
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*-aware Data Collection

- Different apps impose different requirements
- Platform for deploying vehicle applications using an optimal path algorithm to choose the most resource-efficient path



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Security and Privacy

- What are the privacy implications of sharing data with 3rd parties?

Q: Can automakers sell data without my knowledge?

A: **They could**, depending on language in owners' manuals. But under voluntary principles established by the Alliance of Automobile Manufacturers in 2014, most agreed to get **permission** before sharing anything about a driver's **location**, **health** or **behavior** with third parties.

Q: Are there benefits to sharing data?

A: Yes. Upon a **driver's request**, GM will send driving data to **insurance companies** like Progressive and State Farm to see if the driver qualifies for **lower rates**. OnStar will send coupons to your phone for businesses along your route.

Source: McKinsey

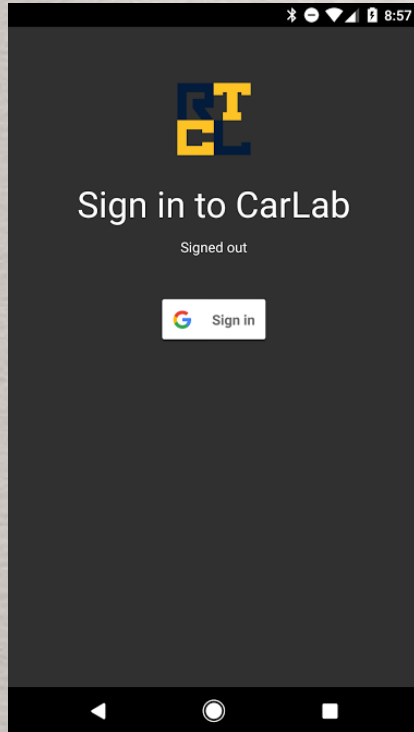


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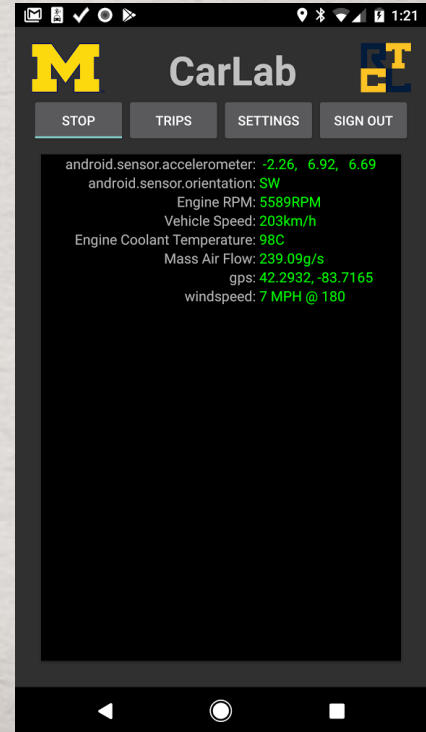
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Current Status



<https://umich-carlab.github.io>



Current Status

- CarLab Development
 - Developed flexible OBD-II (ELM327) data collection smartphone app
 - Developed MongoDB-based cloud-based data storage with user management
 - Internal Code Release and Initial Deployment **10/15/2017**
- Research
 - Privacy implications of OBD-II data



Future Plan

- CarLab Development and Deployment
 - Short-term
 - Visualization
 - Develop middleware/OS
 - Integration of lab members' vehicular apps into a “test” app store
 - Wider deployment and public availability **11/14/2017**
 - Long-term
 - Support for OpenXC, PCAN on HAL
 - Explore V2X data collection



Q & A



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