

The Storage/Management Challenges of the Autonomous Transportation Ecosystem

Alan Messer, Ph.D.

alan@innovationshift.com

CEO InnovationShift - AI/Autonomous/IoT Consultancy

CTO, Mojo Inc. - Leading Connected Car SaaS vendor

Advisor - Microsoft AI Advisory Board

Advisor - DAV Alliance

Former CTO of Connected Car at General Motors

Former Head of Advanced Software at Samsung

Autonomy and Safety Overview

- Many types of Autonomous Vehicles are being considered
 - Each has limitations
 - Varying levels of storage and safety needs
- In addition, storage and safety needs are end-to-end
 - Car
 - Cloud Services
 - Connectivity in-between
- And must be high performance and automotive grade

Data/Storage: L3 Highway/Consumer

Driver must pay attention at all times

- Hands on the wheel (L2):
 - Most 'semi-autonomous' products in market
 - E.g. Tesla Autopilot, OEM ADAS features
- Hands off the wheel (low L3):
 - Highway only
 - E.g. GM SuperCruise, Audi ProDrive



On-vehicle:

- Local processing camera, radar, ultrasonic
- Local HD mapping storage
- Storage for accidents/logging

Cloud:

- HD mapping storage
- Analytics data processing/collection
- OTA Updates

L2/L3 Safety Requirements

Rigorous Testing

Rigorous Security

Fail-safe driver takeover

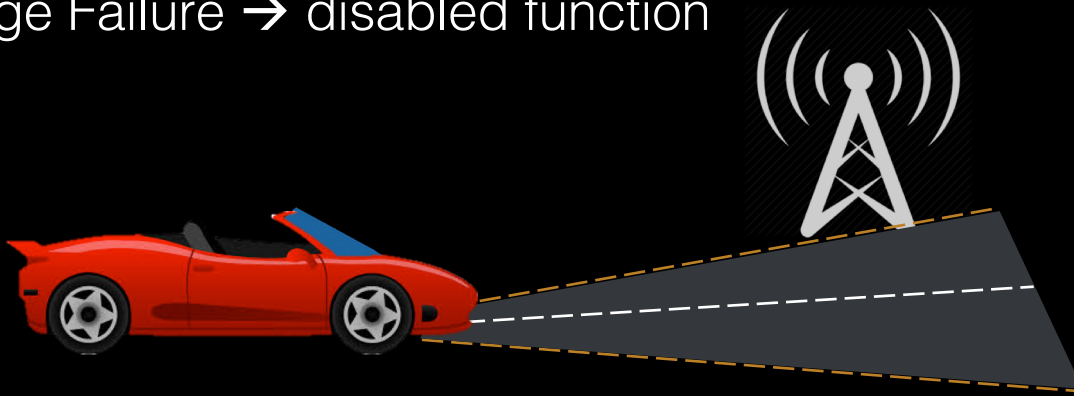
Redundant Sensors

Redundant Processing (Opt)

Storage Failure → disabled function

Redundant Clouds

Redundant Storage for HD Maps



Data/Storage: L4 Robotaxis/Fleet

Taxi with no human driver (you ride in the back)

- E.g. Waymo, Zoox
- On-road 2019 onwards
- Operate only in pre-defined regions



On-vehicle:

- LIDAR, 8+ cameras, radar, ultrasonic
- High performance on car compute
- Ultra HD LIDAR mapping storage
- Storage of past decisions
- Storage for accidents/logging

Cloud:

- AI infrastructure for ML training
- Big data infra for LIDAR mapping
- Long-term storage for accidents/learning
- Simulation storage and processing

L4 Robotaxi/Fleet Safety Requirements

Millions of Miles for Validation

Fail-safe Vehicle Stop

Rigorous Security

Redundant Sensors

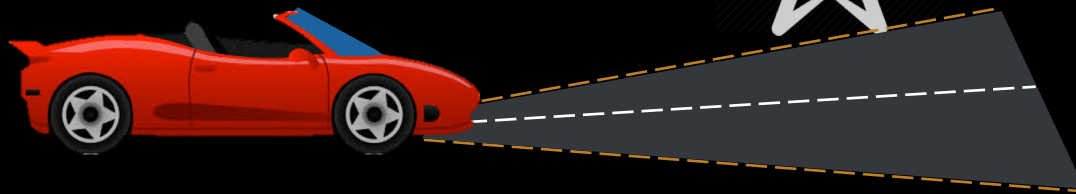
Redundant Processing

Redundant Buses

Redundant Storage

- Machine models
- Mapping
- Compute

Redundant
Connectivity



Rigorous Security
Redundancy: Edge and Clouds
Redundant Vehicle Take Over



Data/Storage: L4 Consumer

Hands off the wheel vehicles

- MY2023 plans from traditional OEMs
- Typically highway or suburban regions

Two approaches:

1. \$\$\$ larger version of L4 Robotaxi
2. Machine-vision-centric



On-vehicle:

- Camera-centric local processing with LIDAR, radar, ultrasonic
- HD Mapping storage for localization
- Storage of past decisions storage
- Storage for accidents

Cloud:

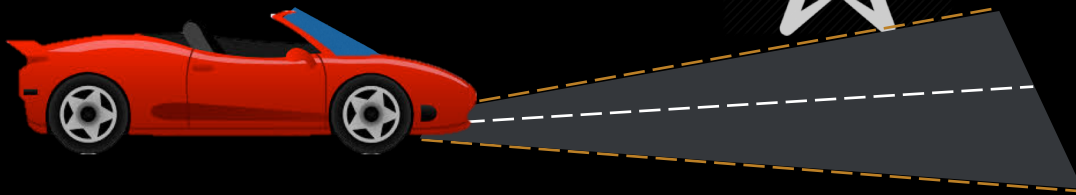
- Video/Image data processing/collection
- Very large AI infrastructure for training
- Big data infra for HD mapping
- Long-term storage for accidents/learning

L4 Consumer Safety Requirements

L4 Robotaxi Plus:

- Components must have a lifetime of 11+ years
- Possible need for Expandability
 - Cheap servicability

Redundant Connectivity



Rigorous Security Redundant Edge and Clouds Consumer Likely To Take Over



Overarching Challenges

- OEMs need solutions for these vehicles now
 - Due to vehicle time-to-market
- OEMs largely need these through Tier1 suppliers
- All vehicle components must be:
 - Automotive grade: heat range, vibration, etc.
 - Have long lifetimes for fleet maintenance or consumer situations
- Price/performance key to getting volume on these use cases
 - Pressure for consumer technologies at automotive grade

Summary

- Storage, safety and redundancy vary a lot
 - Depend on the use cases as well as SAE Levels
- Automotive demands extra requirements on hardware
- But they want great price/performance