

# End-to-End Data/Storage in Autonomy

**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*

# Emerging Autonomous Markets And Storage

- We've all heard of the SAE Autonomous Driving Levels
  - Adaptive Cruise Control thru to no driver intervention driving
- But the market is more complex than that
  - Anything less than Level 5 has limitations and those limitations create different markets
  - Different usages/complexities mean different storage requirements

# 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):
  - Very few in market today
  - Highway only
  - E.g. GM SuperCruise, Audi ProDrive



## *On-vehicle:*

- Local processing camera, radar, ultrasonic
  - Today no LIDAR, but may come
- Local HD mapping storage
- Mapping updates/patches
- Storage for accidents/logging

## *Cloud:*

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

# Data/Storage: L4 Robotaxis

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

- Large push to bring to market quickly
  - Currently in test
  - On-road 2019 onwards
- Operate only in pre-defined regions



## *On-vehicle:*

- Local processing of LIDAR, 8+ cameras, radar, ultrasonic
- 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
- Compliance support Big Data storage
- Analytics data processing/collection
- Simulation storage and processing

# Data/Storage: L4 Consumer

## Hands off the wheel vehicles

- MY2021 plans from traditional OEMs
- Typically highway or suburban regions

## Two approaches:

1. Either larger version of L4 Robotaxi
  - More mapping, etc. —> \$\$\$
2. Increasing Machine vision over LIDAR
  - Less reliance on LIDAR and UHD maps

## *On-vehicle:*

- Camera-centric local processing with LIDAR, radar, ultrasonic
  - Much increased in performance/thruput
- HD Mapping storage for localization
- Storage of past decisions storage
- Storage for accidents



## *Cloud:*

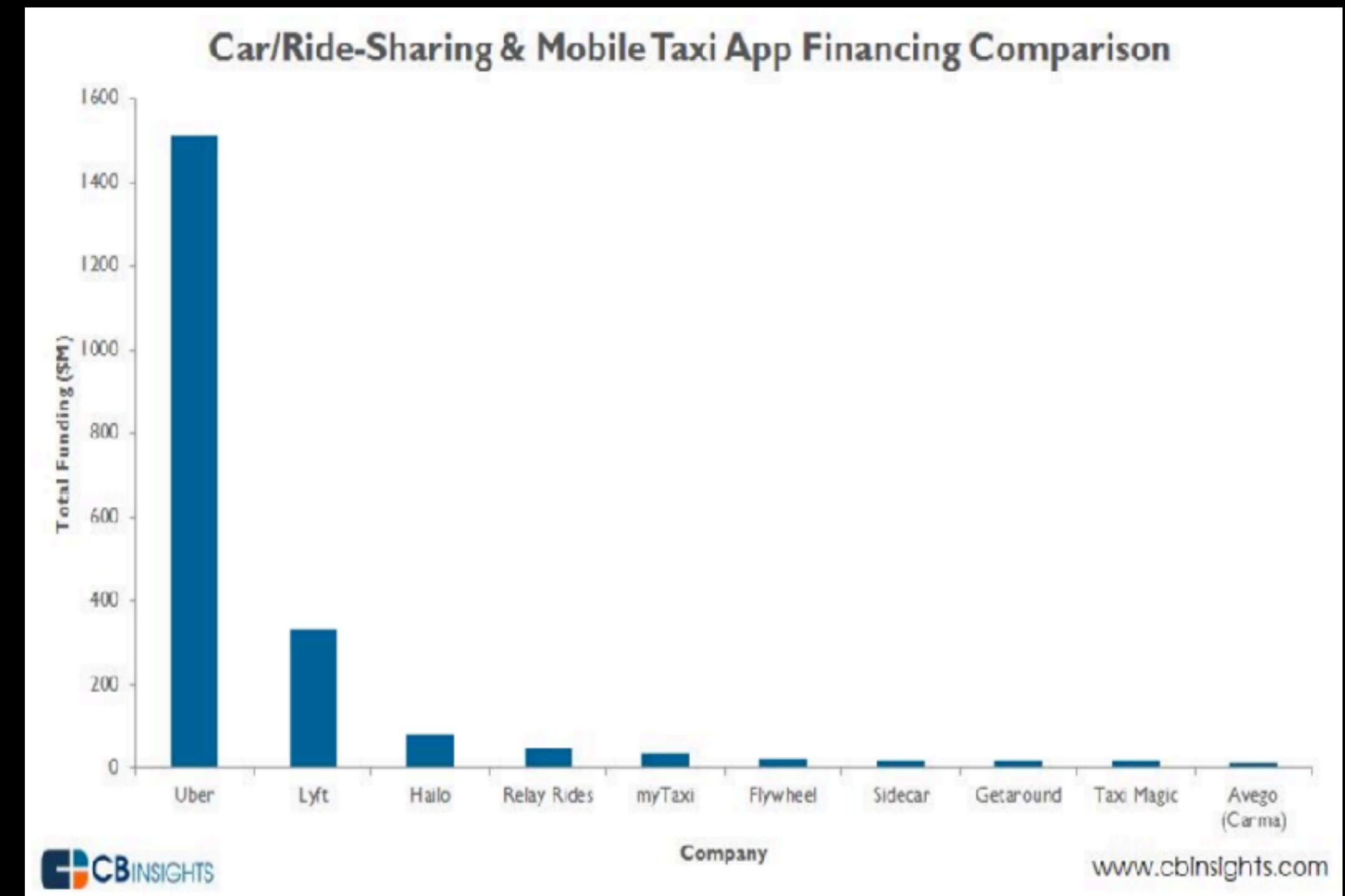
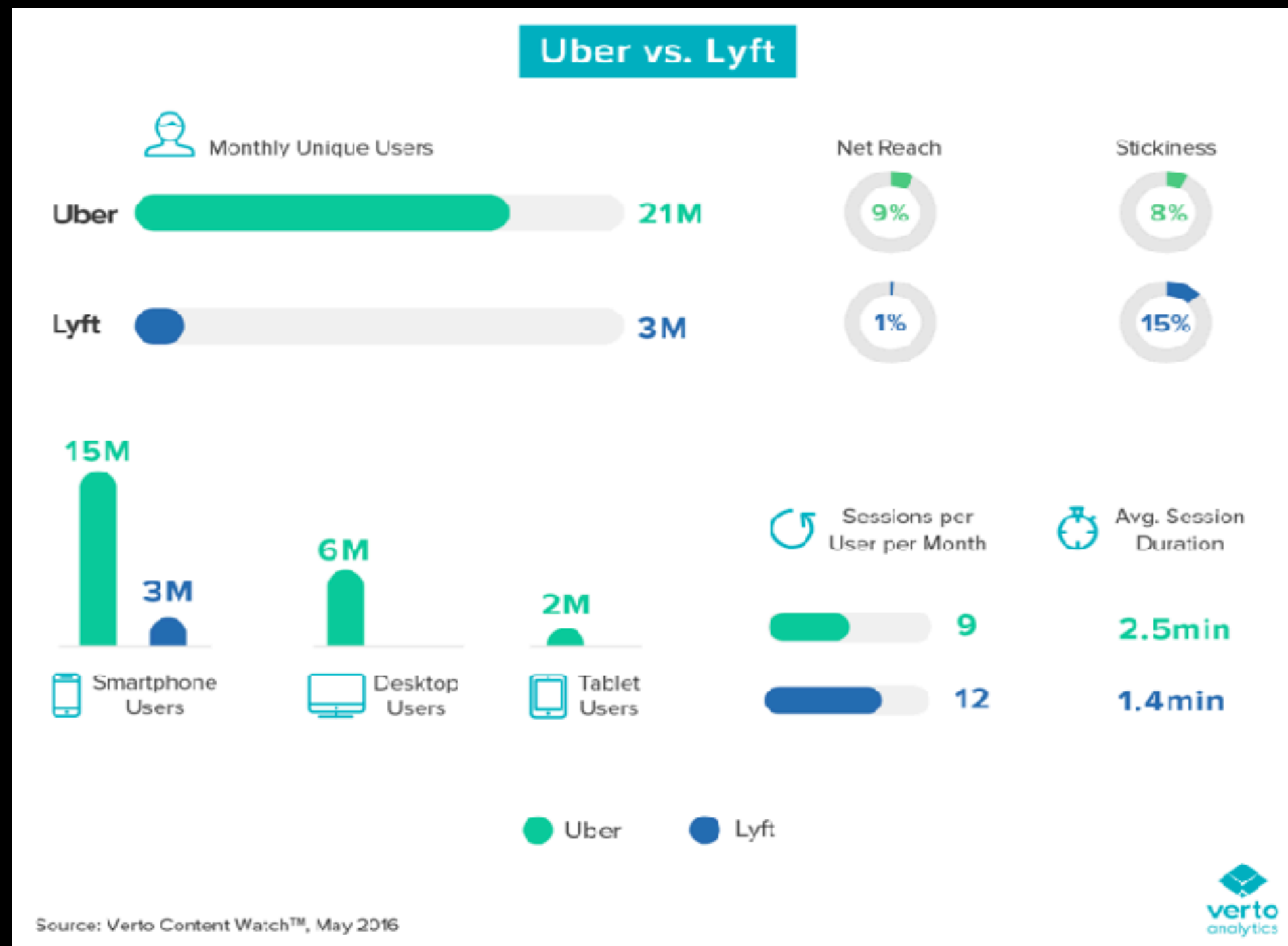
- Very large AI infrastructure for training
- Big data infra for HD mapping or purchase from HD mapping vendor
- Long-term storage for accidents/learning
- Compliance Big Data storage
- Analytics data processing/collection

# Open Challenges?

- The mass market for vehicles will be slow to arrive
  - Vehicle processes take ~3+ years, but thankfully AVs are usually modified vehicles
- Limited view on end-to-end systems by OEMs
  - So many largely focus on the cars and sensing
  - Also Cloud for ML
- AVs often use components from multiple Tier1 vendors
  - Opportunity for the mass market, but higher capability vehicles are largely TBD
- Limited number of high-performance embedded AI systems
  - NVidia, Intel, etc. but embedded SoCs are coming along
- 5G
  - Some of the market ties AVs to 5G
  - All AVs on the road are not-5G and work just fine

BACKUP

# Mobility Service Trends and AV



- User volume is key to mobility services
  - Funding largely matches market share
- Major cost of each trip is driver cost/retention



# Transformation Challenge: 5G 1/2



- 5G encompasses so much, that in reality there are 3 different 5Gs
  - Low-latency 5G
  - Low-power 5G
  - High-bandwidth 5G
- Physics won't allow us to do this with one radio
  - Unless we place devices very near pico-cell towers (\$\$\$)
  - Automotive solutions will need 2-3 different radios in order to fulfill this dream