

ADAS STORAGE SOLUTION

自动驾驶 - 人工智能的终极场景



胡伟懿

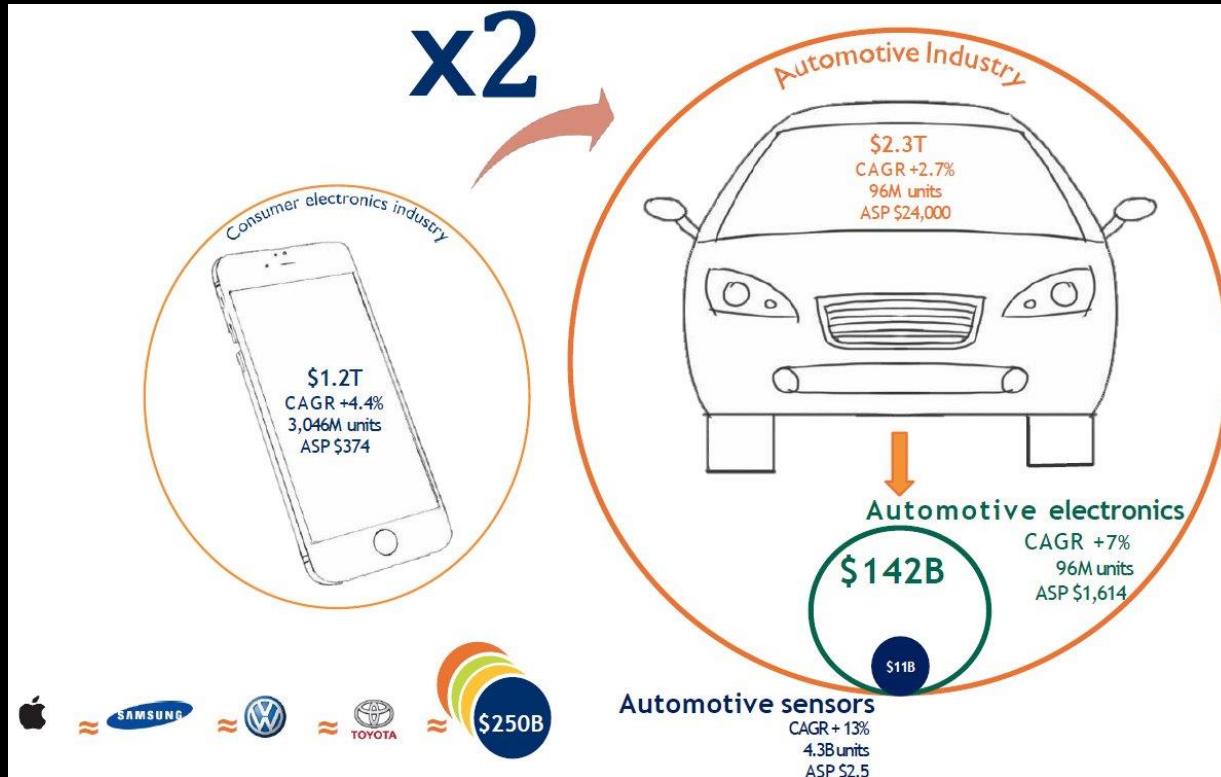
首席全球汽车行业解决方案架构师

ADAS/AD的市场趋势



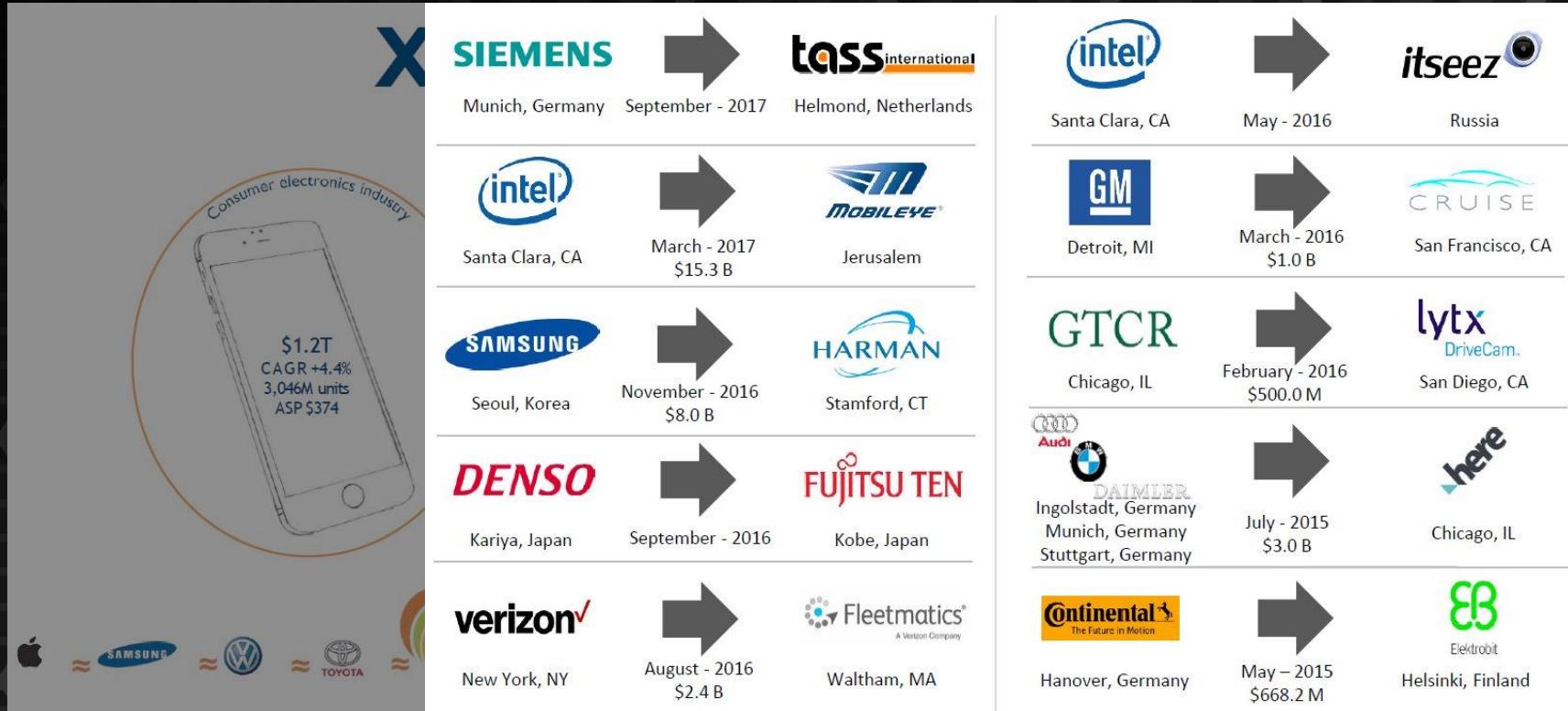
汽车市场：主要价值

Automotive Market: Major Value



全球汽车市场：主要挑战

Automotive Market: Major Changes



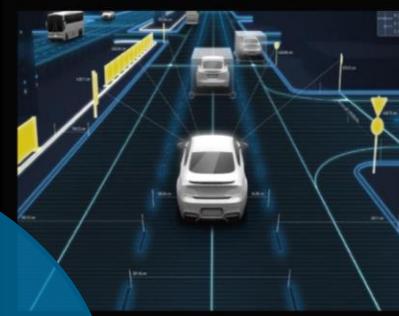
中国汽车行业面临的挑战和机遇

新能源



工程研发

自动驾驶 / 车联网



数字双胞胎



造车新势力



数字化转型

汽车电商

商业模式



BMW and Daimler, Once Rivals, Join Forces to Fend Off Silicon Valley

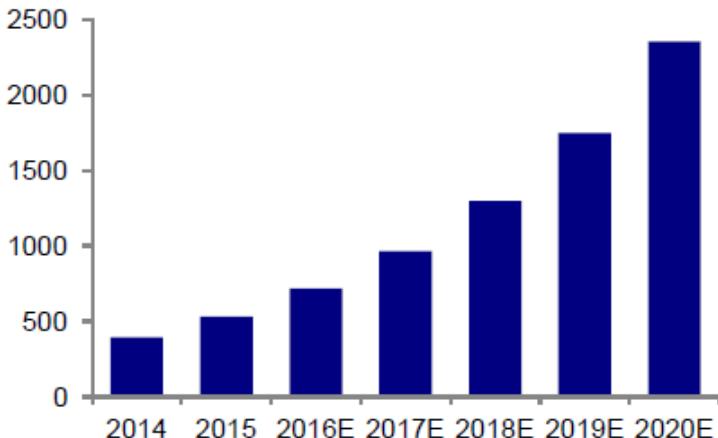
Conditioned, BMW's DriveNow car-sharing service and Daimler's Car2Go will have four million users, the companies said. (AP Photo/DPA, via Associated Press)

By Jack Ewing

March 28, 2018 © Dell EMC. Copyright 2017

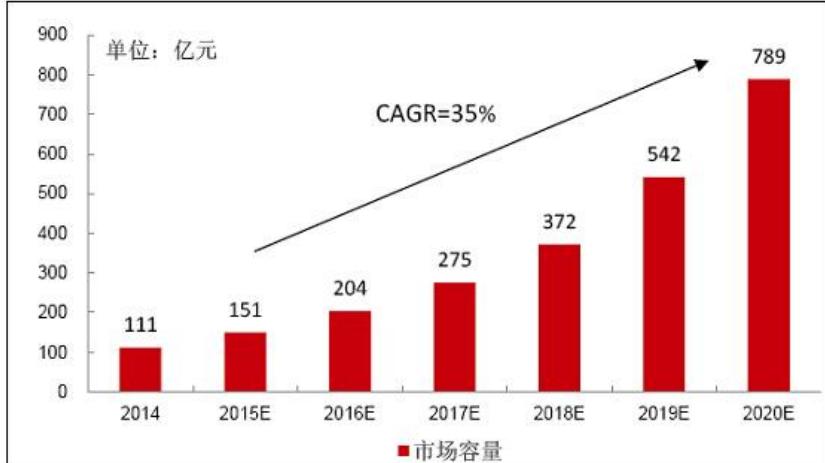
ADAS 市场规模预测

全球 ADAS 规模预测（亿元）



资料来源：中国产业信息网，海通证券研究所

图表 中国 ADAS 市场空间预测

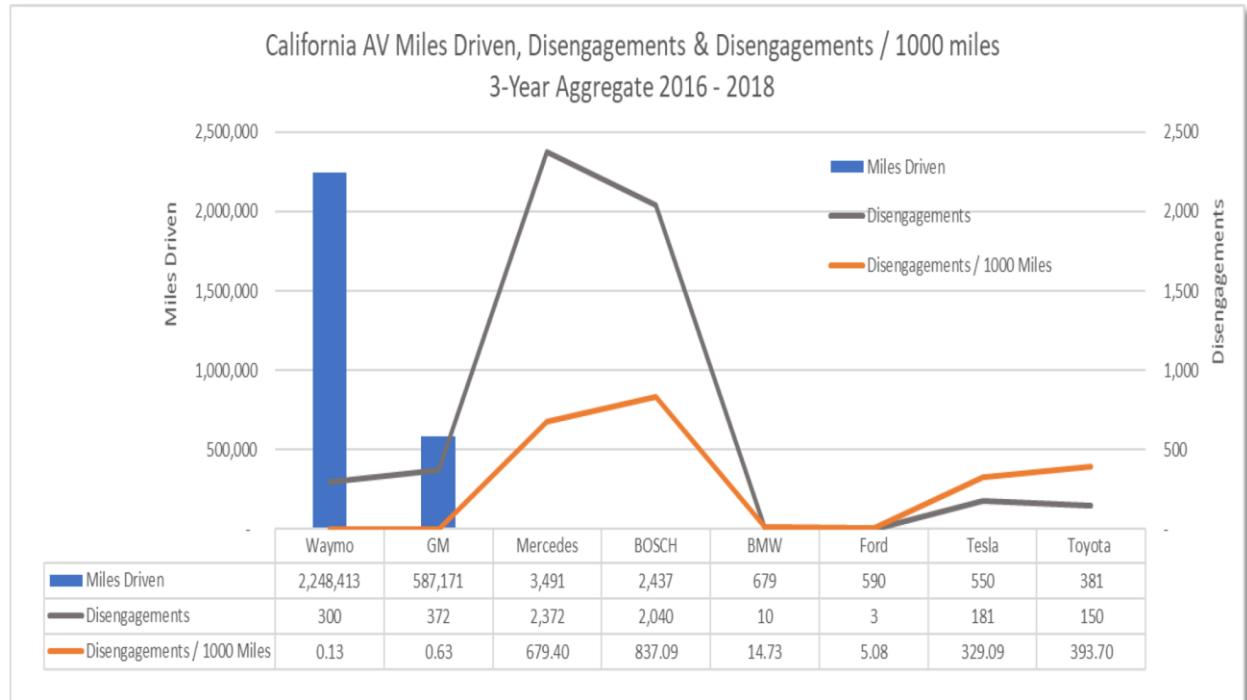


资料来源：中投顾问产业研究中心

- According to the forecast of the Ministry of Industry and Information Technology of China, the market size of ADAS in China will reach 100 billion RMB by 2020.

Test Performance State of California 2016-2018

- Waymo and GM Cruise far outpace in miles driven with the fewest disengagements
- Waymo has a .13 disengagements / 1000 miles over past 3 years (.01 / 1000 miles in 2018)
- High correlation between miles driven and Autonomous Driving functionality
- He who has the data rules the ICV world, but how to manage?



Sources:

California DMV, Testing of Autonomous Vehicles with a Driver Reports (2016 -2018),
Google company data, Forbes, The Verge and [The Last Driver License Holder..., 2019](#)

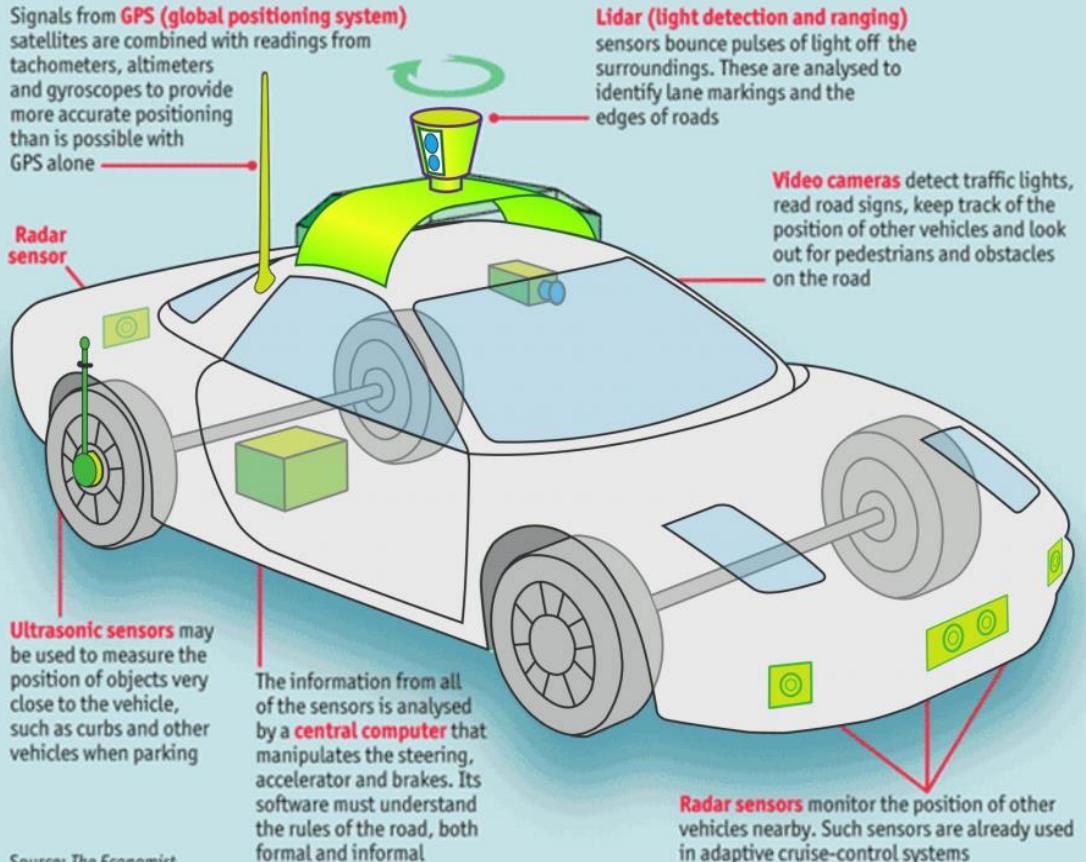
ADAS/AD的发展路线和技术领域



Microsoft

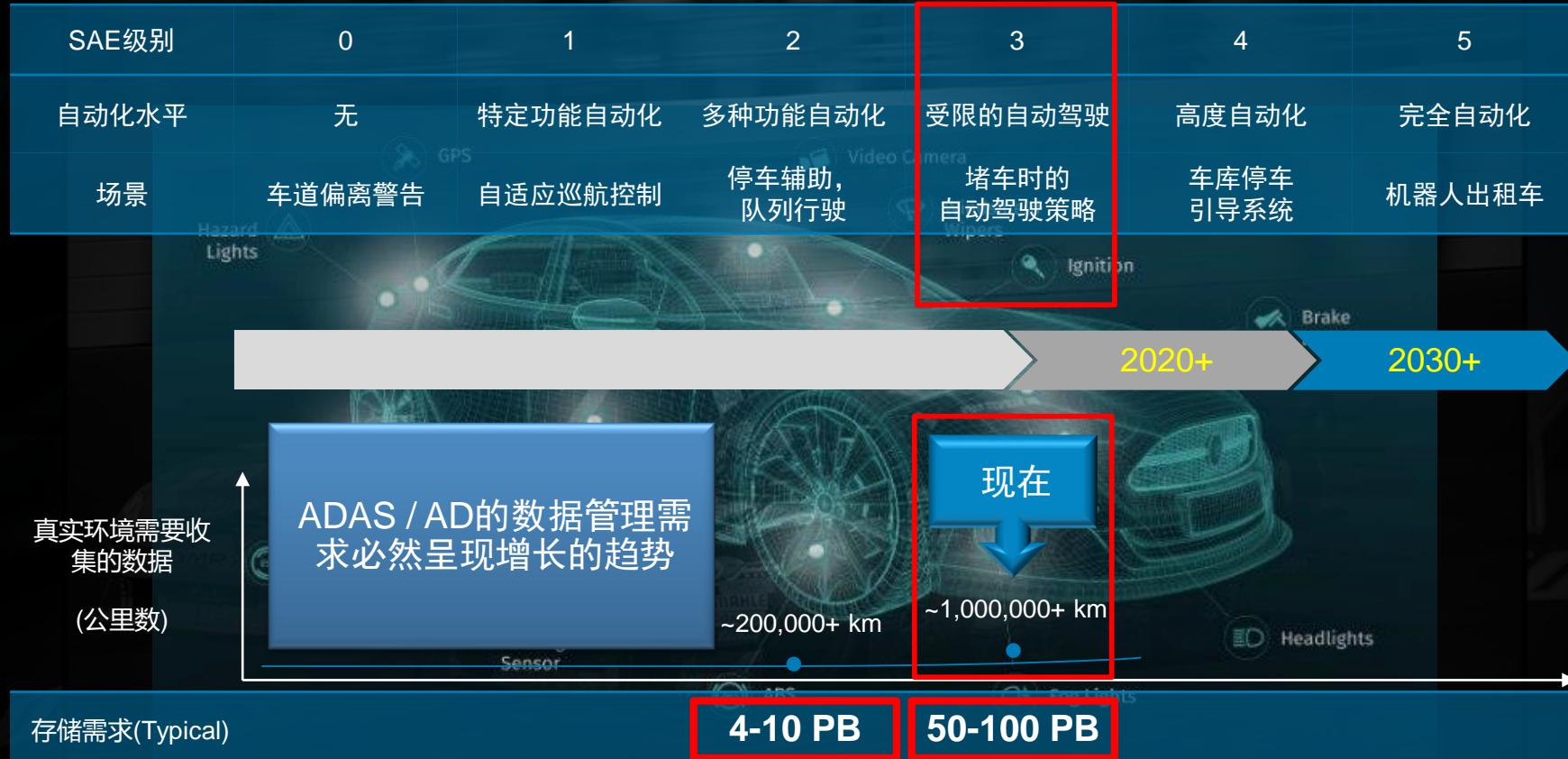
DELL Technologies

HOW A SELF-DRIVING CAR WORKS

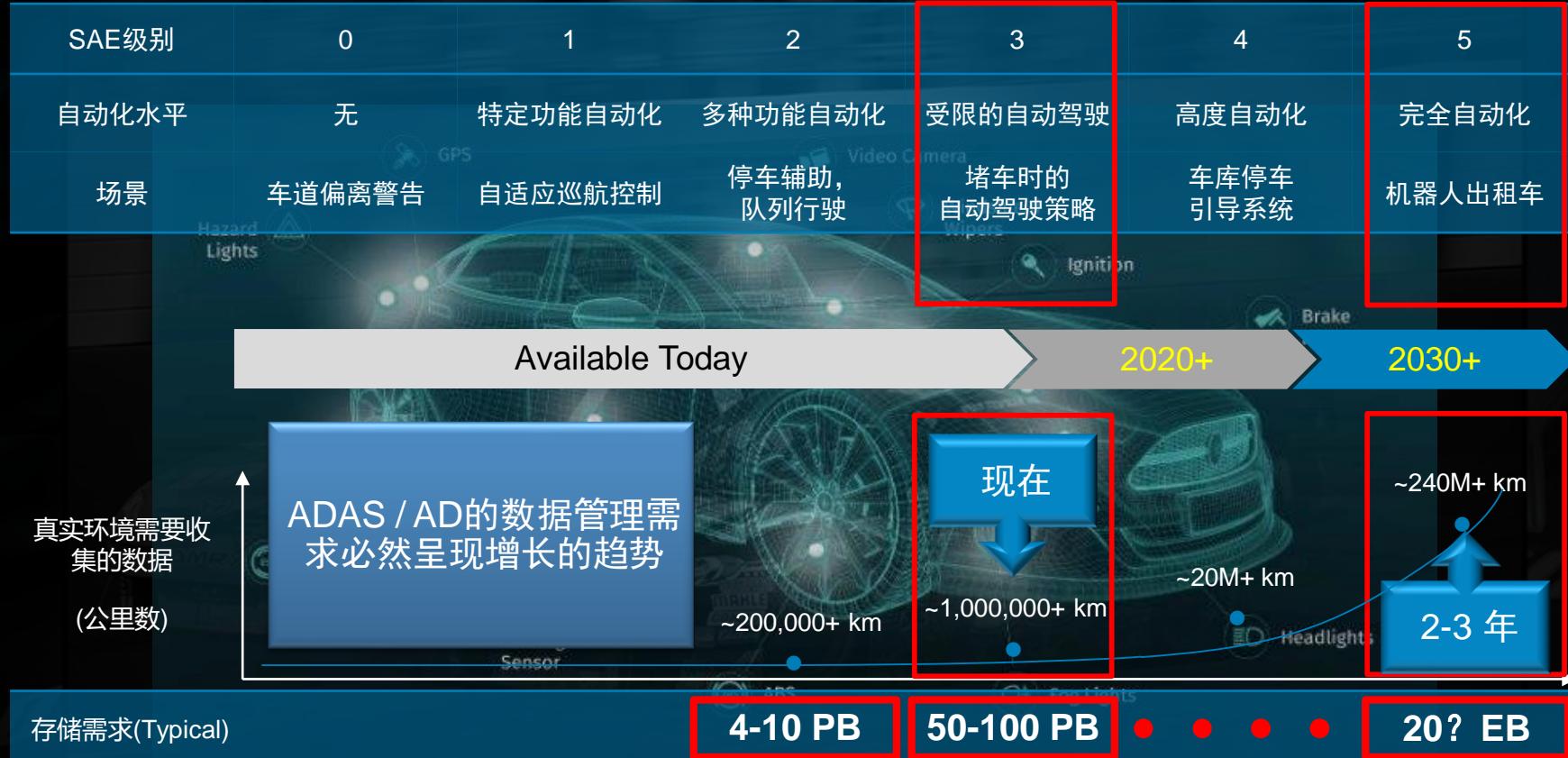


Source: *The Economist*

SAE Level



ADAS 创新依靠海量数据



业界实现自动驾驶的两个技术路径

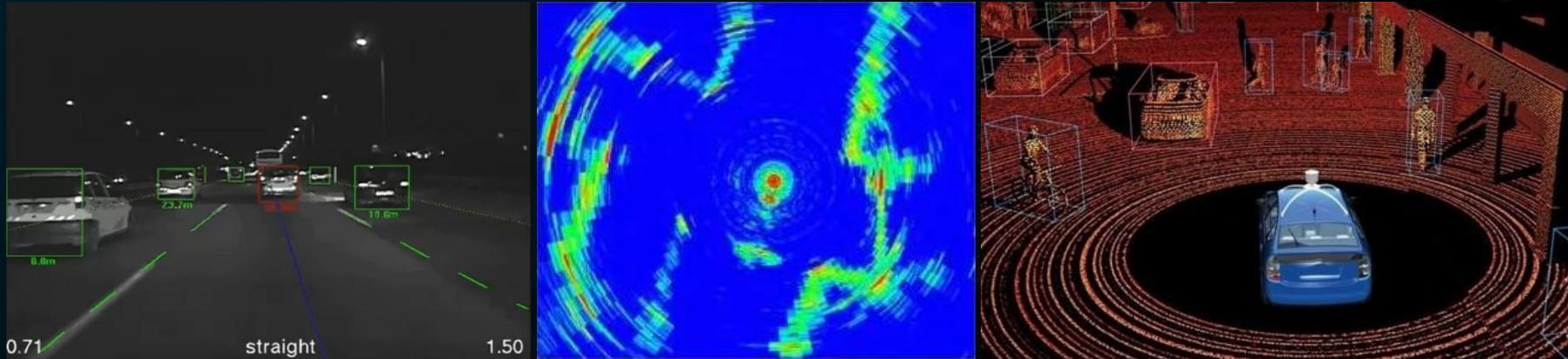
颠覆路线：以科技公司谷歌、百度等为代表的直接自动驾驶路线，依靠高精度地图，配合激光雷达、摄像头、毫米波雷达、超声波传感器、GPS等传感器通过人工智能算法实现完全自主驾驶，他们的核心竞争力是高精度地图的构建，结合各种传感器进行地图的匹配和算法的调试



渐进路线：以福特、通用、沃尔沃、特斯拉等车企以及前后装企业Mobileye等为代表的ADAS逐步升级路线，依靠摄像头、毫米波雷达、超声波传感器等设备，实现在某些环境和条件下的高级辅助驾驶功能，他们的核心竞争力在于整车的设计、制造、销售以及驾驶员辅助驾驶体验的需求挖掘



高清视觉传感器 vs 毫米波雷达 vs 激光雷达

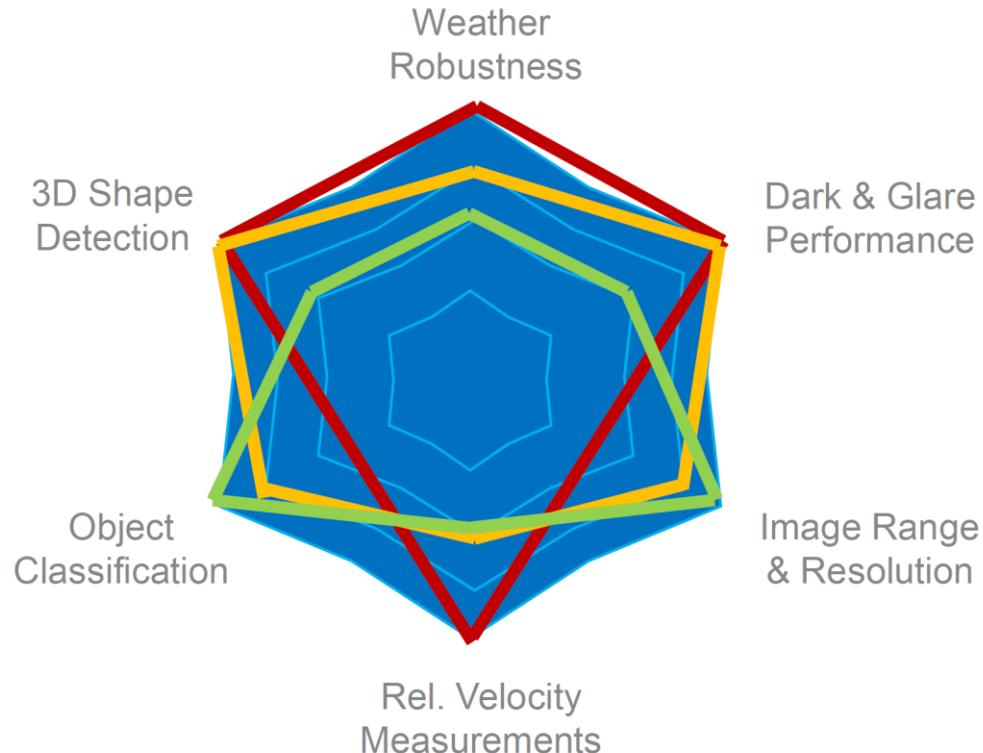


	高清视觉传感器	毫米波雷达	激光雷达
距离	50米	250米	100米-250米
优势	可分辨出障碍物大小和距离，描绘物体的外观和形状、读取标志	穿透雾、烟、灰尘的能力强，具有全天候（大雨天除外）全天时的特点，精度较高	精度很高，探测范围广，方向性强，不受地面杂波影响
劣势	受环境因素以及外部因素影响较大，比如隧道中光线不足，天气因素导致的视线缩小等	由于波长原因，探测距离非常有限，也无法感知行人，对障碍物无法精准建模	遇到烟雾介质以及雨雪天气中表现一般
价格	¥ 500	\$100	\$4W-\$8W(以Velodyne产品为例)

One sensor to cover all requirements?

Advantages and Disadvantages of Radar, LiDAR and Camera

Radar
LiDAR
Camera

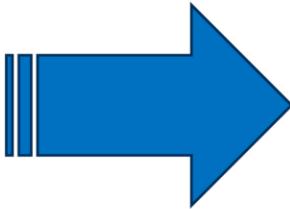


Overview of all sensors needed for AD



Overview of all sensors needed for AD

- 3 x forward looking cameras (stereo + QHD)
- 4-6 x surround-view cameras
- 2 x mirror replacement cameras
- 4 x RADAR
- 4 x corner RADARs
- 2 x LIDAR
- 1 x Infrared cameras
- 8 x Ultrasonic



Sensor Fusion becomes very important

- Increases the detection area
- Reduces false positives
- Increases accuracy
- Increases reliability and robustness of detection area
- Gains additional information for scene analysis



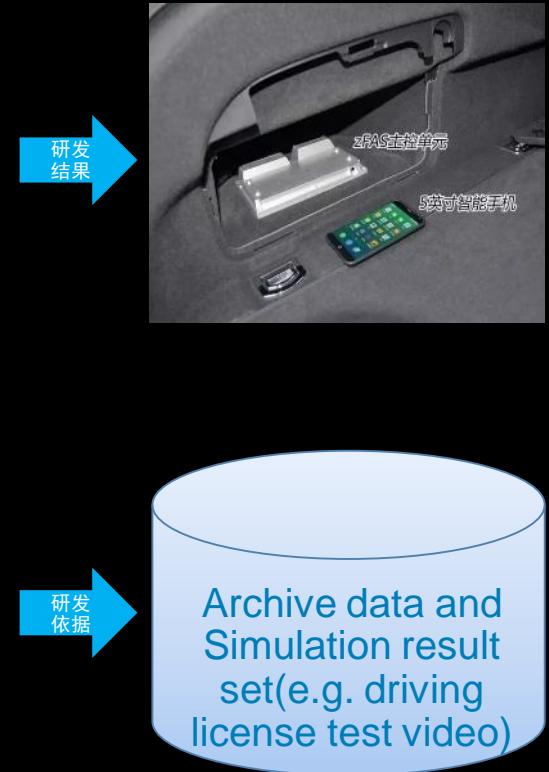
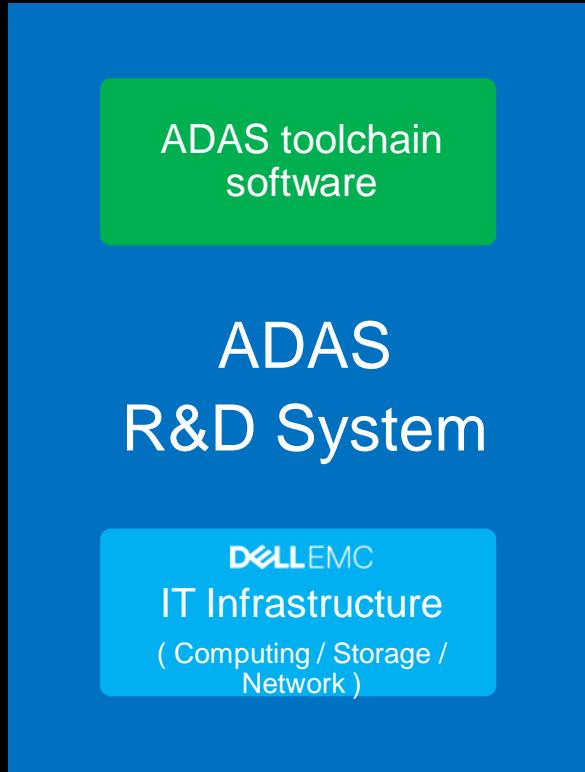
ADAS/AD的研发平台



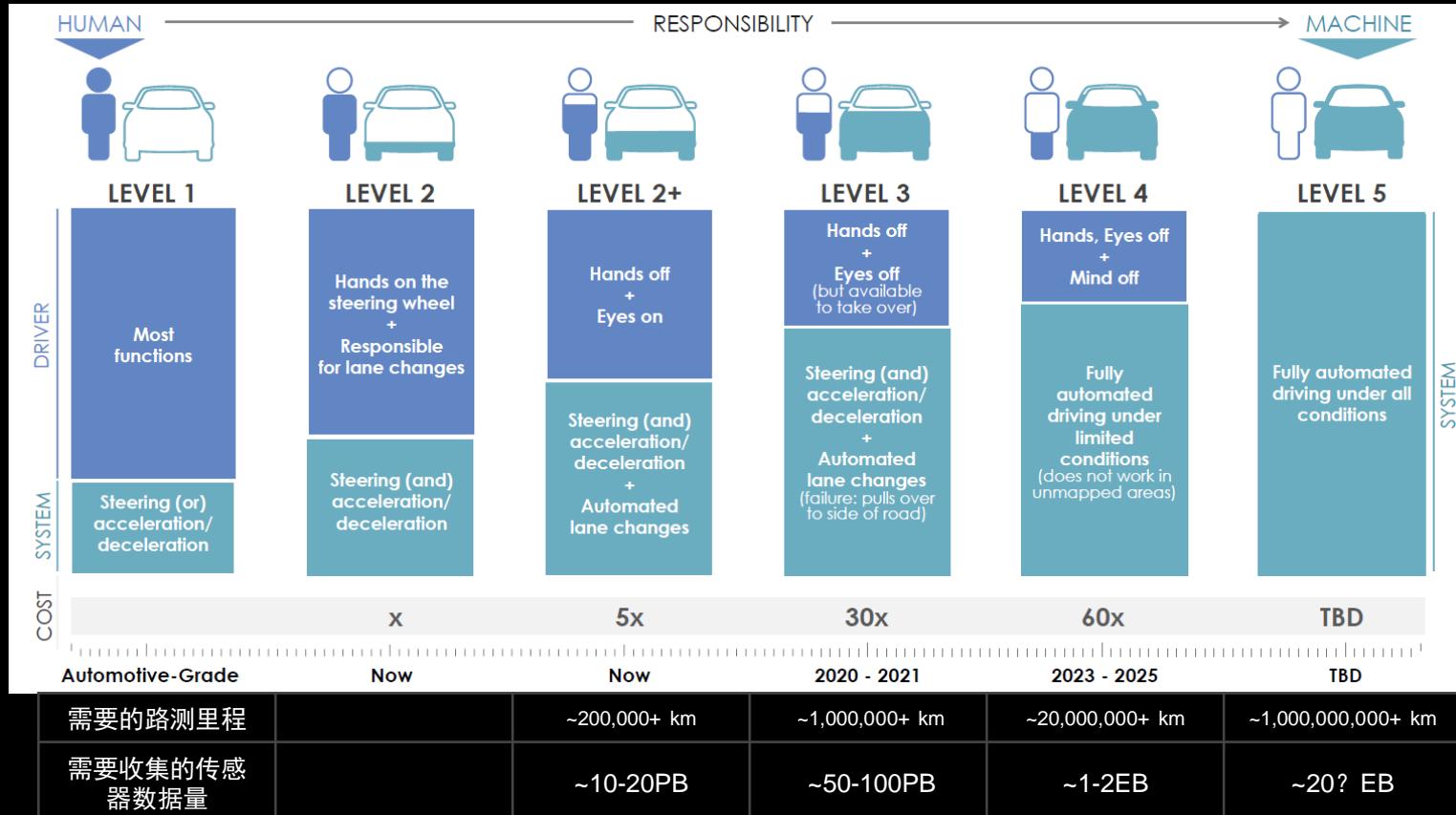
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Simplified View: Input and Output of ADAS R&D System



ADAS等级、成本、时间和数据量

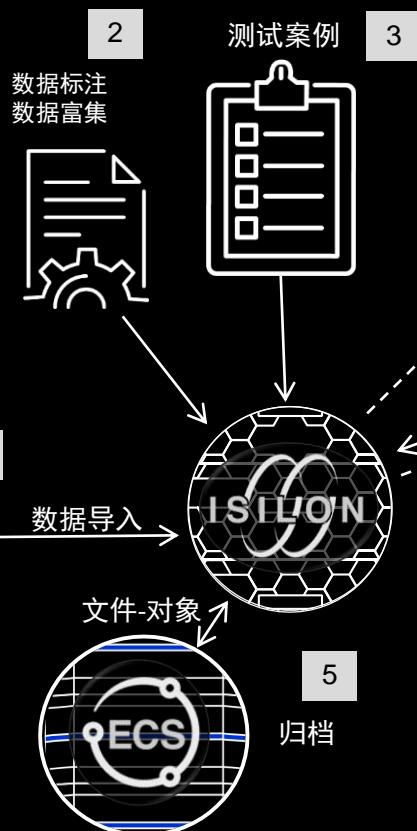
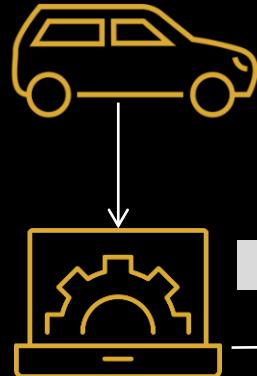


ADAS/自动驾驶并发数据流

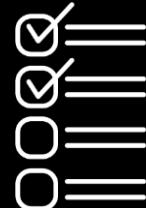


产生的传感器数据：

- 摄像头
- 雷达
- 激光
- GPS
- 声纳
- 总线数据
- 更多..



测试结果报表、
分析和数据管理



深度学习环境



图释：

1. 数据导入
2. 数据富集
3. 数据管理
4. 仿真 / 深度学习
5. 数据归档

HiL/SIL 测试环境

HiL 服务器集群

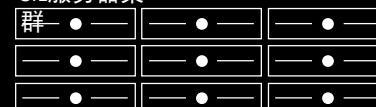
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物理设备

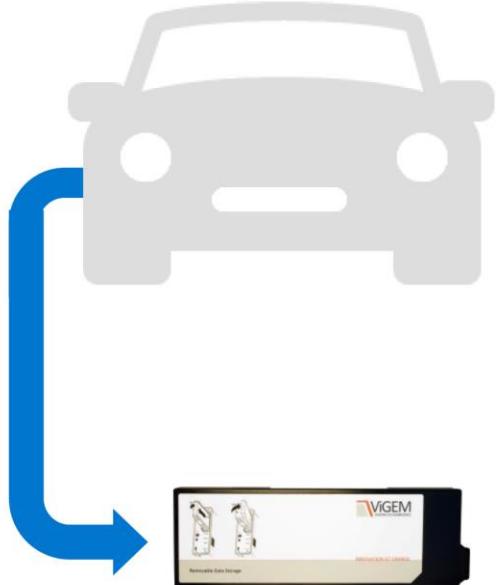
Sensor
ECU



SiL 服务器集群



From data acquisition to server hosting



Storage module

many many
Terabytes per day

- Storage modules ship by overnight express to the data center
- Copy Station performs upload
 - Test drive can continue immediately
 - Easy-to-use for non-engineer test drivers



Copy Station



Dell EMC Isilon
Scale-Out NAS

DELL EMC





Data Challenges

数据的挑战

- Scale of data
大量的数据
- Performance requirements
性能的需求
- Legislation uncertainty
法律合规性的不确定性
- OEM SLAs & archiving
整车厂商对SLA和归档的要求
- Avoiding data duplication
避免重复数据

ADAS数据验证归档 (10-15年)

为什么要保存那么久?

- 整车的生命周期

为什么要求快速数据恢复SLA?

- 软件更新
- 安全召回
- 法律诉讼

归档选择:

- 磁盘
- 云端
- 自动分层归档



主要的痛点:

Service Level Agreement (SLA): 1-7天

价格

易用性

安全性

<https://electrek.co/2016/07/01/understanding-fatal-tesla-accident-autopilot-nhtsa-probe/>
<https://www.engadget.com/2018/05/07/uber-crash-reportedly-caused-by-software-that-ignored-objects-in/>

<https://www.wired.com/story/tesla-autopilot-self-driving-crash-california/>
<http://bigthink.com/natalie-shoemaker/why-google-self-driving-car-crash-is-a-learning-experience>
<https://reason.com/blog/2018/05/07/self-driving-car-blamed-for-an-accident>

人工智能在自动驾驶中的应用



Microsoft

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Self-driving System Requirements



Capability

Designing the system to handle the entire task of driving.



Accuracy

Handle situations safely without a human driver needing to intervene



The Long Tail

All rare driving situations that need to be handled

Perception

Sensor inputs

Prior map



Scene representation

- Objects
- Scene semantics

Perception Complexity

- Variability axis: **objects**
 - types, appearance, pose, ...



Perception Complexity

- Variability Axis: **scene configuration / object relationships**
 - Occlusions, reflections, interactions...



Reflections



Prediction

Need to anticipate future agent behavior

Planning

Generate *vehicle behavior*, which is

- Safe
- Comfortable
- Sends the right signals to other traffic participants
- Makes progress on route

High Quality Labeled Data



Groundtruth Annotation tools

- Context Labeling Tool
- Object Labeling Tool
 - Manual
 - Semi-Automatic
 - Fully-Automatic
 - Keyframe Labeling
- Pixel-pixel Labeling Tool

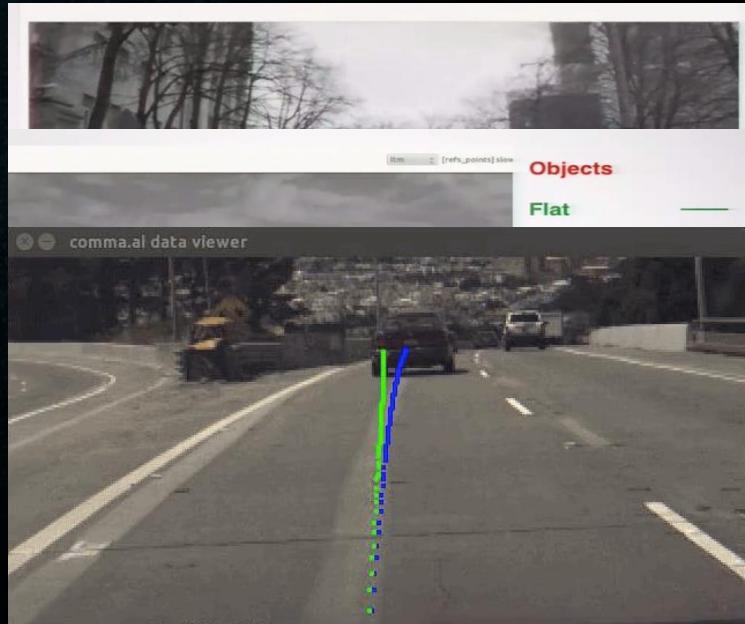


深度学习在自动驾驶领域的应用

- 物体识别及分类
- 可行驶区域检测
- 行驶路径检测



卷积神经网络(CNN)



I/O 对深度学习创新的影响

I/O 瓶颈对AI产生影响：

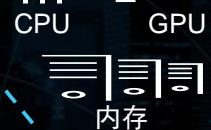
- 延长了模型研发的时间
- 无法完全高效利用GPU
- 限制了数据模型的精准度
- 很难扩展到支持海量数据的生产环境

计算资源: 10s–1000s GPU

带宽需求: 10s–100s GB/s

并发: 1000s–Ms

数据容量: 100s TBs–10s PBs



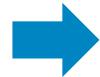
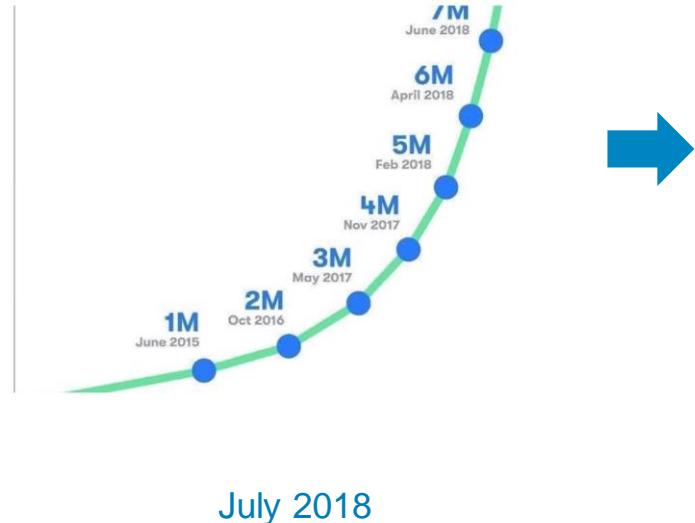
如何测试？

自动驾驶测试车和它的数字双胞胎



John Krafcik
CEO, Waymo
5小时前

Waymo has self-driven 8 million miles on public roads, now at a rate of 25K miles per day. This real-world experience, plus over 5 billion miles in simulation, is how we're building the world's most experienced driver.



Algorithm re-simulation

Specify test environment

The screenshot displays a user interface for configuring a test environment, likely for a simulation or algorithm development. The interface is divided into three main sections: Context, Labeling, and Objects.

Context: This section contains four expandable categories:

- Country:** Unspecified, Albania, Andorra, Austria, Belarus, Belgium (3)
- Road:** Highway (22)
- Weather:** Unspecified (3), Dry (14), Fog, Rain (8), Snow
- Illumination:** Unspecified (3), Cloudy, Day (22), Low Sun, Night

Labeling: This section contains one expandable category:

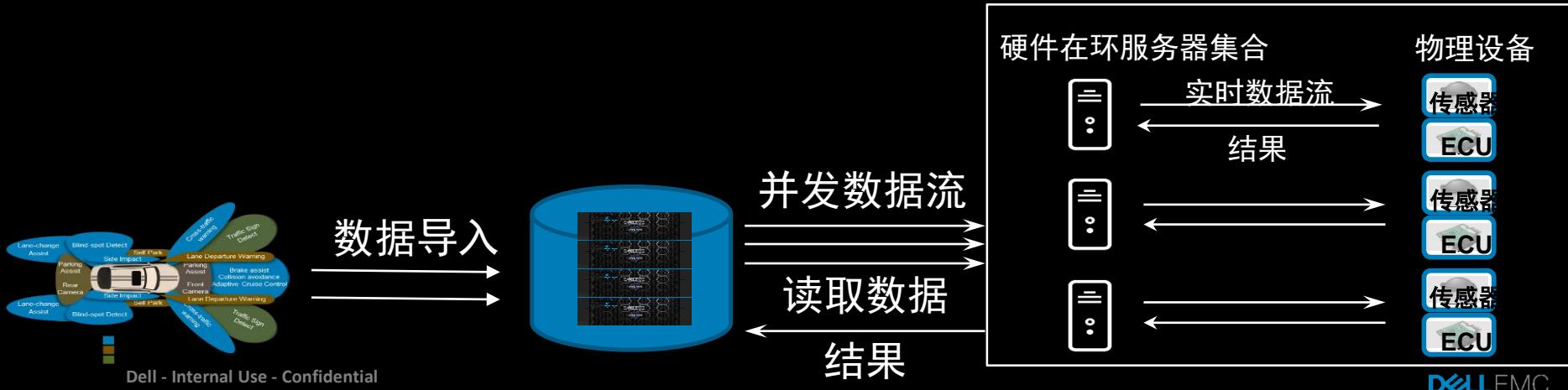
- Event:** Bridge (308), Motorway exit (58), Other objects (6), Tunnel

Objects: This section shows a hierarchical tree of vehicle types under the heading "UnSelect all Objects".

- KFZ (moto_vehicle_label_sub_object)
 - bus (bus)
 - back (Back of the vehicle)
 - side (Side)
 - carrier (Carrier)
 - motorcycle (motorcycle)
 - other (Other vehicle type)
 - personal_car (personal_car)
 - special_purpose_veh (special_purpose_vehicle)
 - trailer (trailer)
 - transporter (transporter)
 - truck (moto vehicle truck)

ADAS仿真测试和验证的性能需求

- 大量复杂的测试数据集以及较短的测试周期 – 并发仿真测试
- 可能有数百个软件服务器或者物理设备同时在读取数据流
- 单个数据流要求150 – 400 MB /s 带宽需求 (可能持续增长)
- 与此同时，也要以GB/s级别的速度导入新数据



Synthetic Scenario Generation

What is real and what is simulated?



Dell EMC对于自动驾驶研发平台的完整解决方案

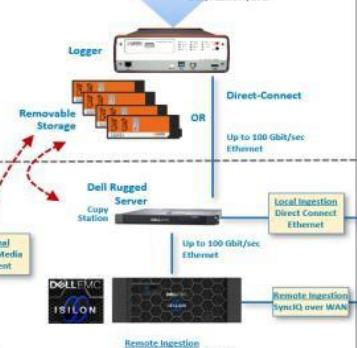
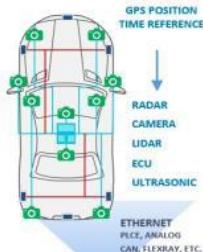


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In-Vehicle Systems

Vehicle Under Test (VUT)



Data Transfer Location

Applications & Management Layer

Application Development

Remote Users

https:

- Centrally Managed
- Personalization Experience
- Windows and Linux
- Secure Access

VXRAIL

VDI Platform

Management Platform



Artificial Intelligence & Simulation Layer

Machine Learning

DELL EMC

cloudera



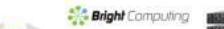
Spark

Data Science Workbench

Deep Learning

DELL EMC

GRAPHCORE



PYTORCH

HPC/SiL Simulation

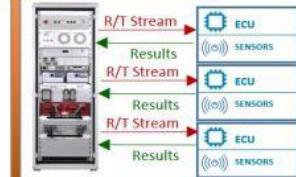
DELL EMC

Bright Computing



TESLA

HiL Test Cells



HDFS/NFS/SMB Low Latency Access Layer – Dell EMC Open Networking

Data Lake Foundation & Data Protection Layer

Data Management Service

DMS Index

Pre-processing

VXRAIL

Dell Ingest Server

Data Lake

DELL EMC
ISILON

Hot and Warm
Storage Tier

Auto Tiering

Off-Site Replication

DELL EMC
ECS

Cold Storage
Tier

Geo-Replication

Data Protection

Warm Storage Tier

Integrated Data
Protection Appliance

Cold Storage
Tier

I C

Zenuity DELL EMC R&D requirements

- ADAS (level 2) – requirements
- Collect x00,000km with low level sensors
- 100% real data
- Data Logging rate from the cars generates about 15TB data per day/per car
- Total expected storage volume: X0PB usable
- X% of data re-simulated within 24hrs
- 50% of data kept



存储架构选项

STORAGE ARCHITECTURE OPTIONS

传统存储 (Traditional Storage) :

“纵向扩展”架构 (“Scale-up” Architecture)

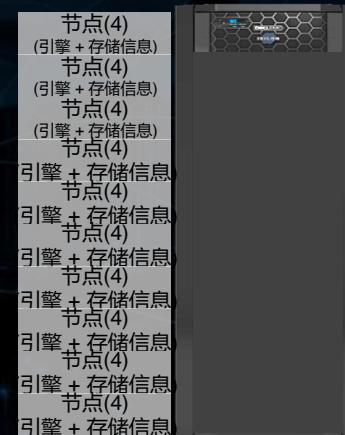


主要特点:

- 较低的CPU与HDD比率
- 单位为百卷 (每个100TB, 手动)
- 多个存储岛
- 存在性能瓶颈
- 不超过20PB的命名空间

Isilon存储 (Isilon Storage) :

“横向扩展”架构 (“Scale-out” Architecture)



主要特点:

- 高CPU与HDD比率 (线性比例)
- 单卷 (自动分层)
- 横向扩展 (数据湖)
- 自动负载平衡 - 没有性能瓶颈
- 不受限的命名空间

Ipsilon Simplicity and ease of use

Single Volume and File System

Automation

- **NO** manual intervention
- **NO** reconfiguration
- **NO** client mount point changes
- **NO** application changes
- **NO storage migrations**
- **NO** RAID or LUNs



Dell EMC: 分布式文件和对象存储的领导者

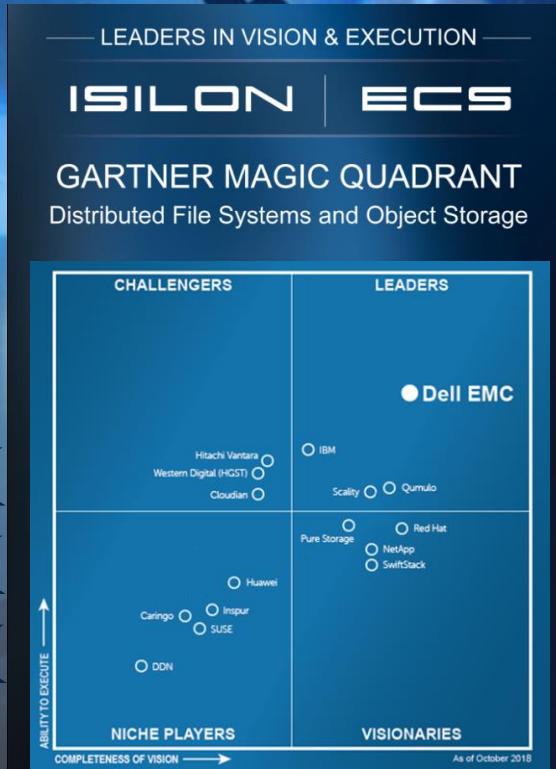
ISILON



IDC Gartner Scale-Out NAS Leader

Primarily File: SMB, NFS, HDFS

>80% Storage Efficiency



ECS



IDC Gartner Scale-Out Object Leader

Primarily Object: S3, Swift and Atmos

48% Lower TCO Than Public Cloud

新白皮书 - ADAS



针对 ADAS 开发与验证的存储 解决方案



2018年5月



2 ADAS 的开发和验证 流程

ADAS 的开发和验证包括各种设计、开发和测试阶段，并考虑了多个方面。在汽车行业，普遍要求严格遵守 ISO 26262 的安全标准。对于生命攸关功能 / 失效保障功能，ISO 26262 建议采用更高级别的测试方法，以涵盖故障注入和 ADAS 错误决策等可能的测试场景。这增加了 ADAS 开发和验证阶段的复杂性和工作量，从而提高了开发时间成本。

2.1 开发阶段的 ADAS 基础架构

02



