Flash Memory in the emerging age of autonomy

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CORPORATE SNAPSHOT

- **Founded in 2007**
- **300+ employees**
- **Headquartered in Menlo Park, California (Silicon Valley)**
- **300+ issued and pending patents**
- **$200m+ funding to date (Series C closed in 2014)**

State of the Industry

L3 systems entering consumer market

L4 pilots operational

State testing legislation & initial federal policies

Federal Legislative Guidelines

NHTSA Federal Automated Vehicles Policy

September 2016

- *Vehicles should record, …,* ***all information relevant to the event… [accident, crash]***
- *… should collect, store and analyze data regarding* ***positive outcomes*** *…*
- *… explore a mechanism to facilitate anonymous* ***data sharing*** *…*

State Legislative Guidelines

California Proposed Driverless Testing and Deployment Regulation

March 10, 2017

- *"**Autonomous technology data recorder**"*
- *…for **30** seconds prior to a collision and at least **5 seconds after** a collision …*
- *… data recorder that **captures and stores** … **sensor data for all vehicle functions** that are controlled by the autonomous technology*

Nevada Administrative Code Chapter 482A - Autonomous Vehicles

Revised April 2014

- *… to capture and store the autonomous technology sensor data for at least **30 seconds** before a collision occurs…*

Where does the data come from and how much are we really talking?

- **RADAR:**
  4-6 Sensors 0.1 - 15 Mbit/s /Sensor
- **LIDAR:**
  1-5 Sensors 20 - 100 Mbit/s /Sensor
- **CAMERA:**
  6-12 Sensors 500 - 3500 Mbit/s /Sensor
- **ULTRASONIC**
  8-16 Sensors <0.01 Mbit/s /Sensor
- **VEHICLE MOTION, GNSS, IMU**
  <0.1 Mbit/s /Sensor

TOTAL SENSOR BANDWIDTH: 3Gbit/s (~1.4TB/h) **or** 40 Gbit/s (~19 TB/h)

What does this mean for storage KPIs?

Let's make some assumptions… a "medium" sensor bandwidth CAV in California

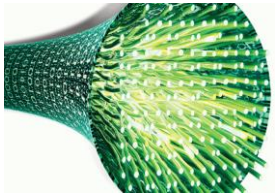
(30s + 5s) * 5 Gbit/s = **22 GB per Event**

Americans drive an average of 17,600 min/year[1]

17,600 min/year * 5 Gbit/s = **660 TBW / Year**

[1] Source AAA American Driving Survey 2014-2015

What does it mean for CAV storage projects?



High bandwidth interfaces

Diverse density & lifetime requirement

Shorter design & validation cycles

Summary

- There will be vastly different bandwidth requirements
- Legislation will continue to evolve
- Validation is an ongoing process
- Storage requirements no longer just driven by features and functions for the customer