

Data Capture and Ingestion in ADAS Development

Lyve Mobile enables frictionless movement of autonomous vehicle test data in a fraction of the time when compared to traditional data transfer technologies.

Solution Summary

Lyve™ Mobile solutions from Seagate® enable AV companies to directly ingest data captured by a fleet of AV sensors. Further, they support frictionless data movement to local data centers for analysis. With capacities ranging from 48TB to 96TB and support for HDD or SSD, the Lyve Mobile Array provides ample storage capacity to cover the immediate needs of daily data capture for each AV in the fleet. The addition of the Lyve Mobile Mount—an accessory built to secure the Mobile Array onto any vehicle and withstand extreme conditions—facilitates data ingestion in real time.

Benefits Summary

- Nearly instant access to daily mass data, which is crucial for MIL, HIL, and SIL test systems
- Leverage Lyve Mobile services and pay only for storage and performance needs
- Does not rely on shared network bandwidth
- Enables users to physically track where data comes from and goes to
- Seamless, agnostic, and cost-effective integration means there's no need to completely rethink infrastructure

As part of the testing and development process for autonomous driving technologies, a single autonomous vehicle (AV) can generate between 20 terabytes (TB) and 50TB of data per day. And that's just for one vehicle. AV testing and development requires a full fleet of vehicles, dramatically increasing the amount of data that must be ingested and analyzed on a daily basis.

Most AV companies rely on shared network infrastructure for the ingestion of data. But ingesting data over a low-bandwidth network can take days or even weeks, making daily AV data ingestion an extremely tedious and burdensome task. As a result, gaining access to test data often takes significantly longer than the process of its capture.

This poses a real challenge to the AV industry since all collected data comes from simulations through model-in-the-loop (MIL), software-in-the-loop (SIL), and hardware-in-the-loop (HIL) test systems. Instant access to collected data is critical to the successful development of AV projects.



Introduction

The race toward entirely autonomous vehicles is in full swing, spurring a highly competitive and transitional period for the industry. As leading AV companies vie for the number-one spot, original equipment manufacturers (OEMs) and tier 1 suppliers are facing challenges of their own. Particularly, they must bring innovations to market with great speed, scale, and intensity—all while containing costs, mitigating risks, managing product complexity, and maintaining compliance.

In this paper, we'll explore the infrastructure challenges facing OEMs and tier 1 suppliers in developing and validating Advanced Driver Assistance Systems (ADAS) technology. When it comes to testing and development for ADAS—which is designed to enhance passenger, vehicle, and road safety—even entry-level storage capacities must be measured in petabytes. As such, we'll propose a storage solution that's optimized for AV workloads—one that delivers high performance, high concurrency, and massive scalability.



The Challenge

Massive amounts of real-world training data are required in the development of ADAS technology. This data is captured by sensors attached to the AV that pick up information over millions of miles of test driving. A single front-looking radar sensor can generate 2,800 megabits of data per second. Once offloaded, this data is used to run tens to hundreds of thousands of concurrent simulations. The amount of data required to feed these simulations depends on the vehicle's level of autonomy.

The Society of Automotive Engineers (SAE) has outlined five levels of automation in regard to autonomous driving (AD), with SAE level 5 constituting a fully autonomous operation. For SAE level-3 automation, up to 200,000 kilometers (km) of sensor data is commonly required. That's over 3,300 hours of data when captured at 60km per hour, which amounts to 4.2 petabytes (PB) of data for a single sensor. As AVs progress toward SAE level 5, and sensors adopt even higher resolutions, the amount of data captured by each sensor is expected to increase by a multitude of thousands.

The extent of the challenge facing AV testing and development is underscored by the fact that each vehicle contains many sensors and each fleet of AVs contains many vehicles. The massive volume of data, generated daily, must be ingested and transferred to a local data center every day. Depending on the technology that's being used (WiFi, LAN network, 4G/5G, etc.), this can take days or even weeks.



The Solution

To be effective, the solution must:

1. Safely attach to the trunk of the car for real time data capture during test drives
2. Support plug-and-play connectivity with universal compatibility for seamless integration inside the car and the data center
3. Deliver mass-capacity storage capable of recording all data from cameras, sensors, and LiDAR
4. Be easy to remove and reattach to the car when offloading data
5. Facilitate data transfers from the car (i.e., the endpoint) to the data center (i.e., the edge)
6. Be vendor agnostic, integrating into any workflow with low impact on existing IT infrastructure
7. Provide subscription-based storage on demand that can scale up or down depending on fluctuating storage needs without necessitating heavy long-term investments

Seagate Solution

Lyve Mobile solutions are an ideal fit for AD/ADAS training workflows. During AV testing and development, companies can leverage the Lyve Mobile Array to store large quantities of data from cameras, sensors, and LiDAR. The Mobile Array can be easily secured to the trunk of an AV using the Lyve Mobile Mount. An optional PCIe adapter can be used with an external PCIe port, as well as USB 3.2 or Thunderbolt 3 when available.

When data is ready to be offloaded, users simply remove the Mobile Array and house it in the Lyve Mobile Rackmount Receiver to transfer data. Once finished, the Lyve Mobile Array can be reattached to the vehicle for continued use. And thanks to its subscription-based service model, companies have the flexibility to easily adapt their storage needs, whether they need to scale up or down.

Partner Solution

The Dell Autonomous Drive end-to-end AD/ADAS ecosystem accelerates development and enables AV companies to go to market faster. An open alternative to a single public cloud data lake, the Dell Autonomous Drive toolchain can reside on premises, in a public and/or private cloud, or any combination of the two. The Dell Autonomous Drive solution streamlines data management—enabling data scientists to cut back on the time they spend locating and preparing data so they can spend more time on advanced capabilities. This also helps AV companies avoid unpredictable costs, as well as demonstrate compliance with industry standards and regulations.



Features & Benefits

Features	Benefits
Lyve Mobile Accessories	Lyve Mobile Array records data while the Lyve Mobile Mount enables users to secure the Mobile Array to the trunk of the car. The Lyve Mobile Rackmount Receiver turns the Mobile Array into a data center storage system for faster data transfers.
<ul style="list-style-type: none"> • Up to 96TB Exos® HDD • Up to 92TB Nytro® SSD 	Capture large quantities of data from cameras, sensors, and LiDAR that are stored on the Mobile Array.
On-Demand Storage with Monthly or Annual Plans	Easily adapt your storage needs as your data collection evolves without heavy, upfront, long-term investments
Multiple interfaces: <ul style="list-style-type: none"> • 2x USB-C for either Thunderbolt 3 (40Gb/s) or USB 3.2 (10Gb/s) • 1 VASP (PCIe Gen3) with Mobile Array PCIe Adapter required • SAS available with Rackmount Receiver option 	Plug and play with universal data center compatibility.
Seagate Secure™ Technology	Offers industry-standard AES 256-bit hardware encryption at rest and in motion. Backed up by superior manufacturing, global support, and service capabilities.
Lyve Client Software	Works seamlessly to enable user-defined automation, data motion, superior security, metadata tagging, universal S3 cloud compatibility, and more.
Portable, Rackable, and Ruggedized	Designed for constant physical movement of data from vehicles to data centers and back to vehicles.



Solution Components



Lyve Mobile Array

Lyve Mobile Array puts mass data in motion from edge to cloud. Designed for edge storage applications, this compact, portable, rackable storage solution easily integrates into any data management workflow. Get versatile, high-capacity, high-performance data transfers. With industry-standard AES 256-bit hardware encryption and key management in a rugged, lockable transport case, this device provides superior transport and security for mass data. Available as a subscription-based service, it offers storage on demand with the flexibility to scale up or down based on fluctuating storage needs.



Lyve Mobile Mount

This secure aluminum mount helps the Lyve Mobile Array withstand extreme conditions. Hold the Mobile Array in place while recording data in a vehicle, boat, or airplane.



The Dell Autonomous Drive Ecosystem

This is an open alternative to a single public cloud data lake, which can reside on premises, in the cloud (public and/or private), or any combination of the two. The solution is a complete autonomous driving data lake reference architecture and workflow. This ecosystem helps avoid the unpredictable and unmanageable costs of utilizing a single public cloud solution.



Conclusion

Lyve Mobile is the ideal storage-as-a-service solution for capturing, importing, and analyzing data from AV test runs. Its large capacity makes it perfectly suited for capturing data from LiDAR, sensors, and car cameras—now and in the future. The Lyve Mobile Mount is perfectly designed for attaching the Lyve Mobile Array to AVs for data ingestion.

Another benefit to using Lyve Mobile solutions for AV testing and development is rooted in its portable and rugged design. Further, extremely fast file transfers make Lyve Mobile a game changer for the industry since daily collected data can be shared and accessed within hours rather than days or weeks.

Because today's development includes SIL—mixing both real-life situations and simulated situations to test the behavior of the vehicles—it's crucial to shorten the time it takes for the data to go from the car to the data center for analysis and then back to the fleet for more simulations and test runs.

As the vehicles continue to become more autonomous, and the complexity of the algorithms increases, the amount of data generated will grow exponentially. Lyve Mobile solutions are already future-proofed to support the evolving challenges of AV testing and development.

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