DELL Technologies

Solution Brief

HARDWARE-IN-THE-LOOP AUTONOMOUS DRIVING SIMULATION

AWS BENEFITS

- Highly Scalable, Reliable and Available Infrastructure On Demand
- 11 9's of data durability with wide range of cost-effective storage classes
- Unmatched security, compliance, and audit capabilities
- Consistent network performance for bandwidth-heavy workloads
- Broadest and deepest set of machine learning, AI services and deep learning frameworks

PXI BENEFITS

- Physical ECU HiL system
- Replay real-world sensor data synchronized to the microsecond, without data loss.
- Real-time high-fidelity environmental simulation

POWERSCALE BENEFITS

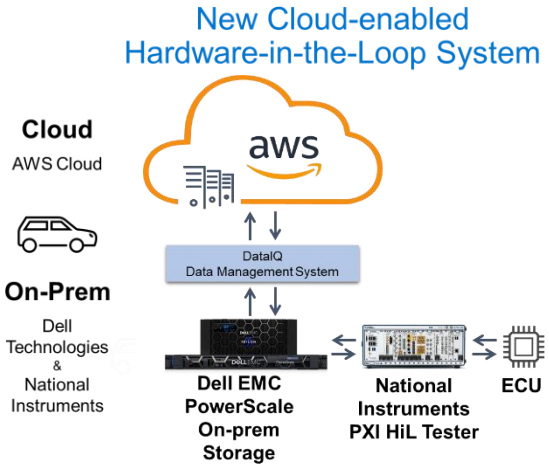
- ADAS-proven, on-prem NAS storage
- DataIQ sensor data tracking, management and movement to/from S3 buckets
- Low-latency, massively concurrent streaming to/from HiL rigs for on-prem ECU validation

Amazon Web Services, National Instruments PXI and Dell EMC PowerScale: High Bandwidth Resimulation and Environmental Simulation

Developing Advanced Driver Assistance Systems and Autonomous Driving (ADAS / AD) solutions requires the ability to collect, store and process data at a massive scale with the massive high-performance compute resources and support for advanced deep learning frameworks. ADAS / AD is all about safety – which at some point in the development lifecycle requires accurate testing with real physical hardware. By combining the full suite of infrastructure services and deep learning frameworks provided by Amazon Web Services (AWS), the National Instruments (NI) PXI modular hardware platform, and Dell EMC PowerScale high-performance NAS storage, engineers can capture and manage millions of miles of real-world sensor data on public cloud, and replay that data to physical hardware with precise timing and no dropped frames of data. Accurate validation is assured, streamlining environment setup without compromising performance.

Validating Physical Hardware Becomes a Reality

HiL testing is a key step of any ADAS / AD design flow. Whether streaming synthetic sensor data generated on-the-fly, or real-world sensor data, HiL testing requires custom,



physical hardware that is not available on traditional public clouds. With sensor data on public cloud, distributed world-wide, and measured in 100's to 1000's of petabytes, it is essential that your HiL hardware and ADAS / AD infrastructure are architected to work seamlessly throughout the ADAS development lifecycle. You need to assure compatibility and accuracy in order to match real-world conditions.

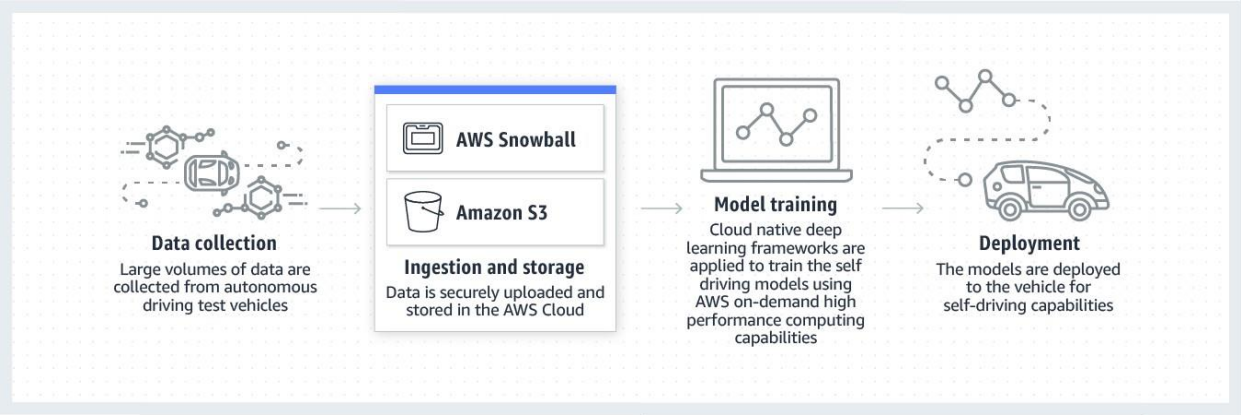
Hardware-in-the-loop: ADAS / AD Development

Bringing an autonomous vehicle to market is an incredibly complex task requiring the careful orchestration of many moving parts. Capturing sensor data is only the beginning, and testing the final solution is but one critical stage. An entire flow must be developed with massive quantities of data at its core. By partnering, AWS, Dell Technologies and NI can provide a tested architecture and solution enabling engineers to take advantage of the flexibility and scalability of cloud-based services, the performance of on-prem infrastructure and the accuracy of HiL testing. With this new HiL architecture, customers can avoid common challenges caused by inadequate tooling and suboptimal infrastructure.

Amazon Web Services for Automotive

A Full Suite of Services to Support ADAS / AD on AWS Cloud

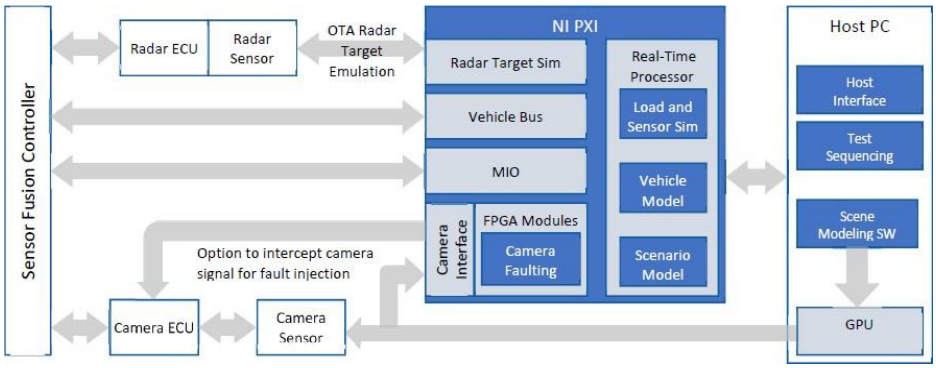
AWS's scalable and globally available storage and compute capacity as well as support for deep learning frameworks enables the collection, ingestion, storage and analysis of autonomous vehicle data to support full-scale autonomous vehicle development. AWS Deep learning machine and container images optimized for frameworks such as Pytorch, TensorFlow and Apache MXNet accelerate your algorithm training and testing. AWS Greengrass provides edge computing with machine learning inference capabilities for real-time processing of local rules and events in the vehicle while minimizing the cost of transmitting data to the cloud.



National Instruments PXI Platform

Replay Data Recorded in the Field with High Fidelity

Record field data from ADAS sensors can be replayed in the lab to simulate driving and increase test repeatability and test coverage. Real, recorded data is better for testing because algorithms can misinterpret 3D rendered scenes designed for the real world. Timing in replay applications is critical, and the NI replay systems provide extremely accurate timing and synchronization to ensure that your perception algorithms get sensor data just as it occurred in the real world.



PXI HIL System Architecture for Testing Active Safety Systems

Sensor Fusion HiL and Integration with Virtual Environments

Integrate scene generation tools with hardware I/O to play back simulated scenarios for validating the sensor fusion and decision-making algorithms on ADAS controllers. Scene generation from all the leading environmental simulation software tools increases test coverage because scenarios can be created to meet specific test requirements. The open software architecture enables you to use the best simulation tool for the application.

Dell EMC PowerScale Network Attached Storage

Massive Throughput, Low Latency On-prem Storage for HiL Data Streaming

PowerScale is an ADAS development-proven, Enterprise NAS solution that bridges the gap between public cloud and on-prem HiL testing. Architected for massive concurrency and low latency, PowerScale is ideal for performance critical, time sensitive ADAS workloads including sensor data streaming to HiL test rigs. PowerScale is powered by the OneFS disk operation system which offers DataIQ technology for managing ADAS sensor data, including worldwide data tracking and movement to/from AWS S3 buckets. With ADAS development change is inevitable, and as vehicle operation approaches full autonomy, performance requirements become even less predictable. With this reality in mind, PowerScale was architected to grow seamlessly with your project in terms of capacity and performance, providing the flexibility to maximize ROI.

AWS, Dell Technologies and National Instruments Benefits

Successfully developing advanced driver assistance systems requires solutions that can scale to meet exponentially growing sensor data and the compute requirements to leverage it. This starts in-car and extends through to the data center, whether on-prem or in the cloud, where infrastructure must support massively parallel, concurrent data ingest, AI/ML/DL, and PiL/MiL/SiL/HiL workloads. HiL hardware platforms are particularly sensitive to infrastructure, where even a single dropped frame of data, or data not accurately synchronized to the microsecond, is unacceptable. With the AWS, Dell, National Instruments partnership you can work confidently knowing that your infrastructure – including HiL hardware - was architected to meet these stringent requirements.

About Amazon Web Services

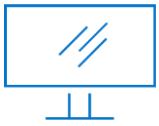
For 13 years, Amazon Web Services has been the world's most comprehensive and broadly adopted cloud platform. AWS offers over 175 fully featured services for compute, storage, databases, networking, analytics, robotics, machine learning and artificial intelligence (AI), Internet of Things (IoT), mobile, security, hybrid, virtual and augmented reality (VR and AR), media, and application development, deployment, and management from 69 Availability Zones (AZs) within 22 geographic regions. Millions of customers—including the fastest-growing startups, largest enterprises, and leading government agencies—trust AWS to power their infrastructure, become more agile, and lower costs. To learn more about AWS, visit aws.amazon.com.

About National Instruments

National Instruments offers a variety of solution integration options – all customized to your application specific requirements. You can use your own internal integration teams for full system control or leverage the expertise of our worldwide network of alliance partners to receive a turn-key system. For more information, visit https://www.ni.com, send e-mail to info@ni.com or call 1-888-280-7645.

About Dell EMC PowerScale

Dell EMC PowerScale provides the leading Enterprise grade scale-out NAS platform that scales from terabytes to 10s of PBs of capacity in a single file system. The OneFS file system has unmatched storage efficiency with utilization capacity up to 80% and enterprise features such as data deduplication to save even more space and further lower overall total-cost-of-ownership (TCO). PowerScale has industry leading data protection with the ability lose up to four nodes and still operate with no data loss. PowerScale stays simple to manage regardless of how your environment grows - allowing you to manage your business and not your storage.



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