

Autonomous Driving: When time to market counts but safety cannot be compromised

Challenges facing autonomous systems suppliers

As an automobile electronics supplier you're looking to accelerate time to market for new autonomous driving offerings. Simulations that validate features and scale are an essential part of the design process. Simulations must meet or exceed the highest levels of safety requirements.

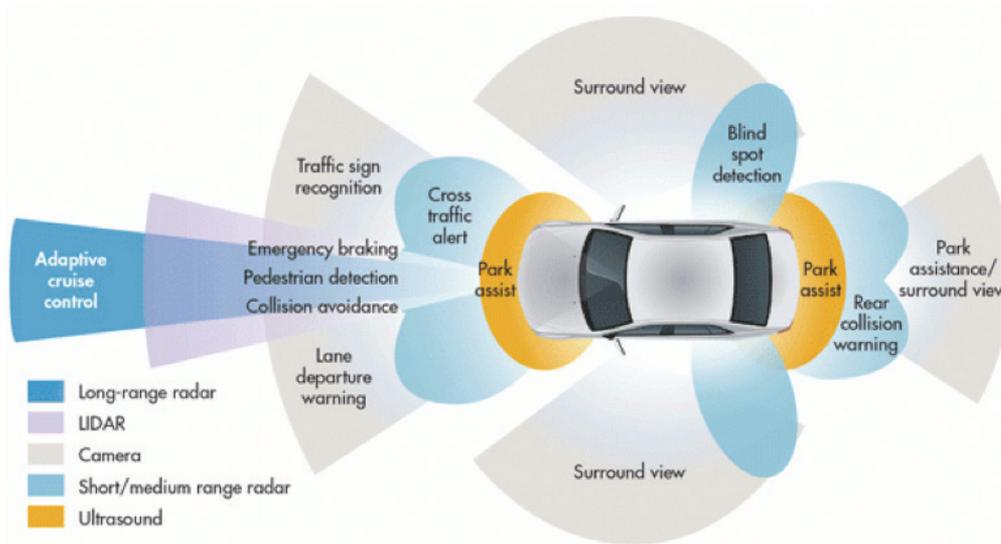
The key to accelerating time to market for autonomous systems suppliers is directly proportional to the number of simulations that can be conducted against new offerings in any given time. Autonomous systems simulations require vast amounts of sensor data. Any slowdown of the infrastructure supporting your data dramatically reduces the simulation rate, and as a result your time to market.

Virtual Instruments, as the leading provider of Infrastructure Performance Management (IPM) solutions in the market, has played a critical role in helping autonomous systems suppliers identify and resolve performance issues that affect simulation time. Our testing and monitoring solutions can validate and assure your data storage performance and can tune and optimize your overall infrastructure.

Highlights

- Time to market is a major competitive advantage for Autonomous Driver Systems technology providers
- Simulations are a critical requirement for ADAS success
- ADAS simulations IT infrastructure can't go down or slowdown
- WorkloadWisdom is the key to ensuring storage infrastructure can meet simulation requirements
- VirtualWisdom is the key to ensuring infrastructure performance in production

Introduction



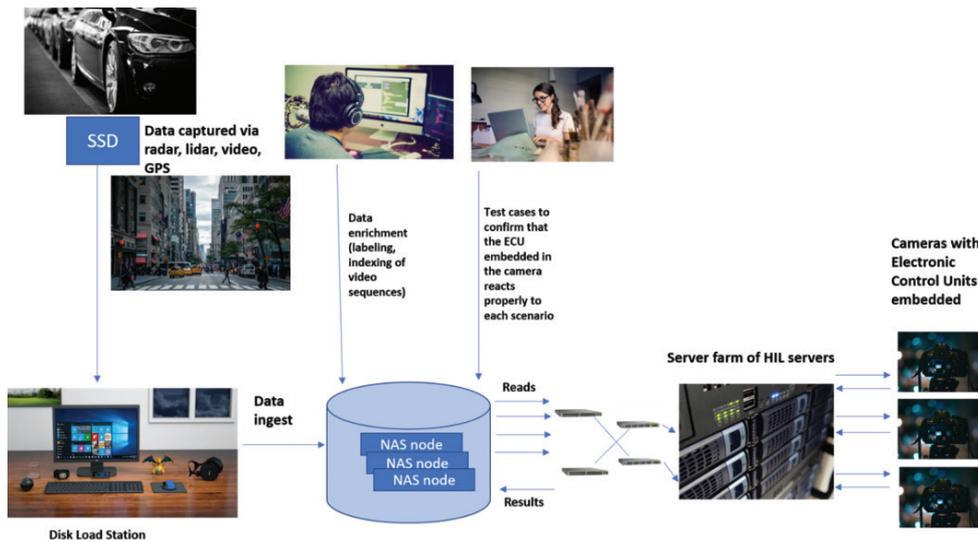
Advanced Driver Assistance Systems (ADAS) aim to eventually deliver a car that is autonomous and can drive itself. The impact of ADAS adoption is evident across the automobile industry from Toyota “Safety Connect & Service Connect” in the Toyota Avalon to Nissan safety features like “blind spot warning” and “rear cross traffic alert” in the Nissan Rogue Sport.

From parallel parking to complex actions like reading traffic signs, ADAS automation has many levels of autonomy, starting at SAE Level 0 (Lane Change Assist, Lane Departure Warning or LDW, Anti-lock braking or ABS and Driver Steering Recommendations or DSR) to full-fledged SAE Level 5 (the self-driving taxi). Building a control unit for any of these SAE levels requires capturing data over millions of kilometers and creating simulations that can model any scenario. To appreciate the amount of data involved, consider that a single self-driving car (out of a dozen or more) can generate over 4 terabytes of data in an hour and a half of driving!

When it comes to running simulations, government regulations may require that hardware devices like the camera and the Electronic Control Unit (ECU) be part of the workflow.

Your simulation workflow might be as follows:

- Test cars are used to capture data using cameras, radar, Lidar (which measure distance to a target using lasers) or GPS. This captured data is then stored in a solid-state drive in the car.
- This drive is transported to an ingest disk load station that uploads the data into a NAS cluster using a protocol like SMB or NFS.
- The video data is accessed over NFS or SMB protocols and enriched by the addition of metadata.
- The simulation server (one of 100s of simulation servers in a server farm) running the simulation software pulls data from the NAS cluster and streams it to a physical camera with an Electronic Control Unit (ECU).
- The ECU analyzes the incoming stream of data, translates it into driving commands which are sent back to the simulation server.
- Test software then determines if the ECU reacted properly to each unique situation, a typical situation might be a human being crossing the street ahead of the car.



In the above scenario, you may have 100s of Hardware in the Loop (HiL) simulation servers streaming data from your scale-out NAS cluster. What if the simulation servers are receiving streaming data at rates lower than expected but the NAS cluster doesn't display any obvious issues on the storage side? What if your network operations group declares that there are no issues in the switched Ethernet Network. Where do you turn next?

Accelerate your testing using Virtual Instruments technology

In the pre-production phase, WorkloadWisdom, the Virtual Instruments Storage Performance Validation Platform, allows autonomous systems suppliers to capture and simulate production workloads to identify bottlenecks, tune infrastructure, identify the optimal storage solutions and drastically improve the throughput of simulations.

WorkloadWisdom enables you to conduct what-if scenarios, dialing up and down the synthetic workloads that represent the load generated by one or more simulation servers. You can automatically test infinite permutations along all network paths, empowering proactive tuning of the network and storage infrastructure that affect simulation performance.

The alternative to WorkloadWisdom involves a costly and painful approach to creating workload simulations by purchasing, installing and configuring numerous simulation servers and related infrastructure, writing and maintaining complicated scripts, and accounting for any OS, driver or firmware changes with every upgrade.

Or you can take a simpler and less disruptive turnkey approach by using Virtual Instruments solutions. With Virtual Instruments, you can now dramatically reduce the TCO normally involved in purchasing,

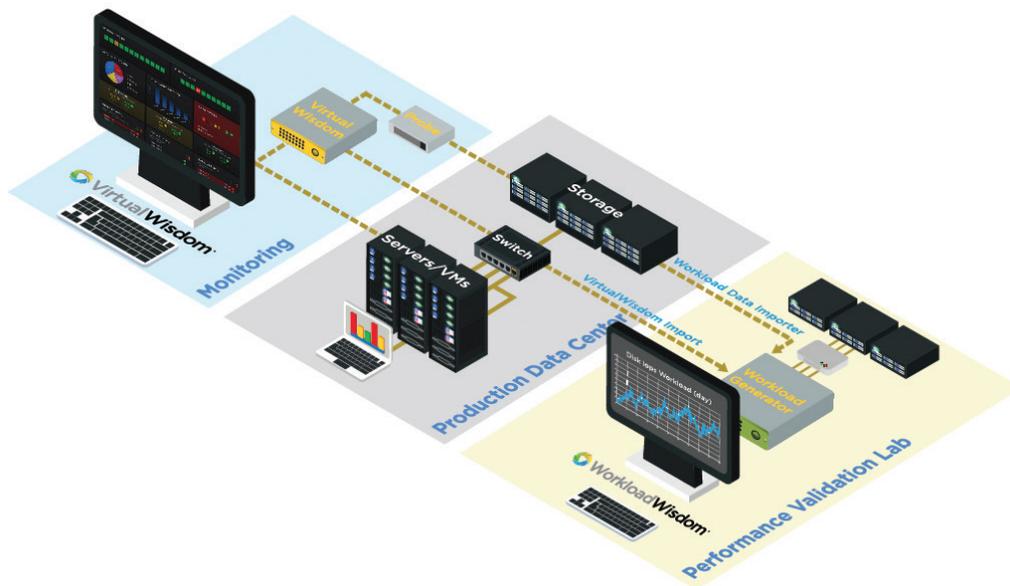
configuring and running numerous simulation servers in pre-production and have much more accurate simulations.

In the production phase, you need a way to monitor and ensure that the guidance given to you in pre-production by WorkloadWisdom is followed in production by the physical servers and you don't end up having to randomly overprovision your NAS cluster.

The VirtualWisdom infrastructure monitoring platform helps by assuring service levels, predicting capacity, balancing workloads and getting to root-cause of infrastructure issues that can hold up a steady rate of successful simulations.

Our market leading wire data and loss-less Performance Probe for VirtualWisdom can be used to observe every single I/O exchange on the wire for either Ethernet based Network Attached Storage (NAS), Fibre Channel based Storage Area Networks (SAN) or iSCSI-based SANs. It then passes along the wire data to VirtualWisdom to provide cross-infrastructure domain correlation, analysis, recommended remediation actions and dashboard and report visualizations.

The FC, iSCSI or NAS Performance Probe collects over 400 metrics related to the FC, NFS, SMB or iSCSI protocols at a microsecond level that enable you to see the subtle performance variations or slowdowns that impact simulation performance that other solutions miss. This facilitates root-cause analysis and resolution of flow control issues, extended write response times and the impact of noisy neighbors. You can also use the NAS or SAN Performance Probes to capture live workloads for replay via WorkloadWisdom. This helps you avoid setting up and fine-tuning numerous server and application configurations to simulate changes in workloads.



VirtualWisdom delivers unique storage infrastructure visibility and value through its App-centric approach by:

- Assuring application data performance**
 Using custom analytics to identify trends, policies based on tiers of applications, application discovery, and topology maps to visualize application and infrastructure paths.
- Continuously enabling the balancing of workload infrastructure**
 Using custom analytics for workload analysis, VM coordination and placement, storage port balancing, network path & queue optimization.
- Accelerating problem resolution & enabling proactive issue avoidance**
 Using anomaly detection, trend and pattern matching, case management, and runbook-based investigations.

Together VirtualWisdom and WorkloadWisdom help eliminate performance concerns about your simulation infrastructure so you can focus on your main goal— to run more simulations per day, so you can better test new innovations against safety parameters. In the long run, this ensures greater satisfaction from your end customer, the automobile manufacturer, as your product advances them into a leadership position in delivering autonomous self-driving cars to the market.



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