DELL TECHNOLOGIES AND TECH MAHINDRA:
THE IDEAL PARTNERS FOR AUTOMOTIVE ADAS / AD DEVELOPMENT

WHITEPAPER

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Summary

The automotive industry is facing a revolution spurred on by the adoption of in-vehicle high tech. Perhaps no other innovation poses greater benefits and challenges than the development of advanced driver assistance systems/autonomous driving (ADAS/AD) technologies. ADAS/AD requires massive investments in infrastructure. The cost of infrastructure accounts for roughly 30% of total program costs. ADAS/AD developers need dedicated, scalable, multi-tenant data centers to collect PBs of data every week for ingestion, cleaning, distribution, simulation, and processing of data at high speeds with minimal cost. ADAS/AD development involves thousands of engineers working across various engineering centers scattered across the world. Over and above these requirements, there are multiple regulations from various countries around data protection and data security that mandate handling, masking, and processing data. Technology development and engineering innovations must work together to ensure the success of ADAS/AD programs. Scalable infrastructure, technology, and domain expertise are needed to build an appropriate architecture that can utilize the best combination of on-premises and cloud to ensure performance and safety with optimal cost.

The engineering function of any organization owns the budget for ADAS/AD programs. Here, the CIO is responsible for supporting these programs by building and managing the infrastructure. Sizing of the infrastructure remains a challenge for most of the companies as the Engineering function knows little about infrastructure and vice versa for the CIO's team. Combining world-class automotive services with the world's largest infrastructure vendor, Tech Mahindra and Dell Technologies are uniquely equipped to help automotive companies as they navigate this transition. Whether looking for hardware, tools, automotive design services, or even fully managed, world-wide data centers, Dell Technologies and Tech Mahindra are ready to deliver. The following are a few highlights of why Dell Technologies and Tech Mahindra are the right choice to depend on for your current and next-generation ADAS/AD needs.

Industry Trends for ADAS / AD development

Globally, Automotive industry investment in ADAS is projected to reach US $95 Billion by 2029, at a CAGR of 16.9% during 2028-2029. Despite CAPEX pressure from the 2020-2021 COVID-19 pandemic, automotive companies are still expected to follow their investment plans to meet their pre-defined goals for ADAS/AD development..

The demand to further develop autonomous driving technologies like LiDAR, Radar, V2X communication, deep learning, and sensor fusion is superseding demand for traditional automotive technologies. Stringent government regulations and increased government support pertaining to the safety of vehicle are also expected to drive growth in the ADAS market.

This chart illustrates why you must invest in infrastructure and resources today to plan for the future needs of ADAS/AD development:
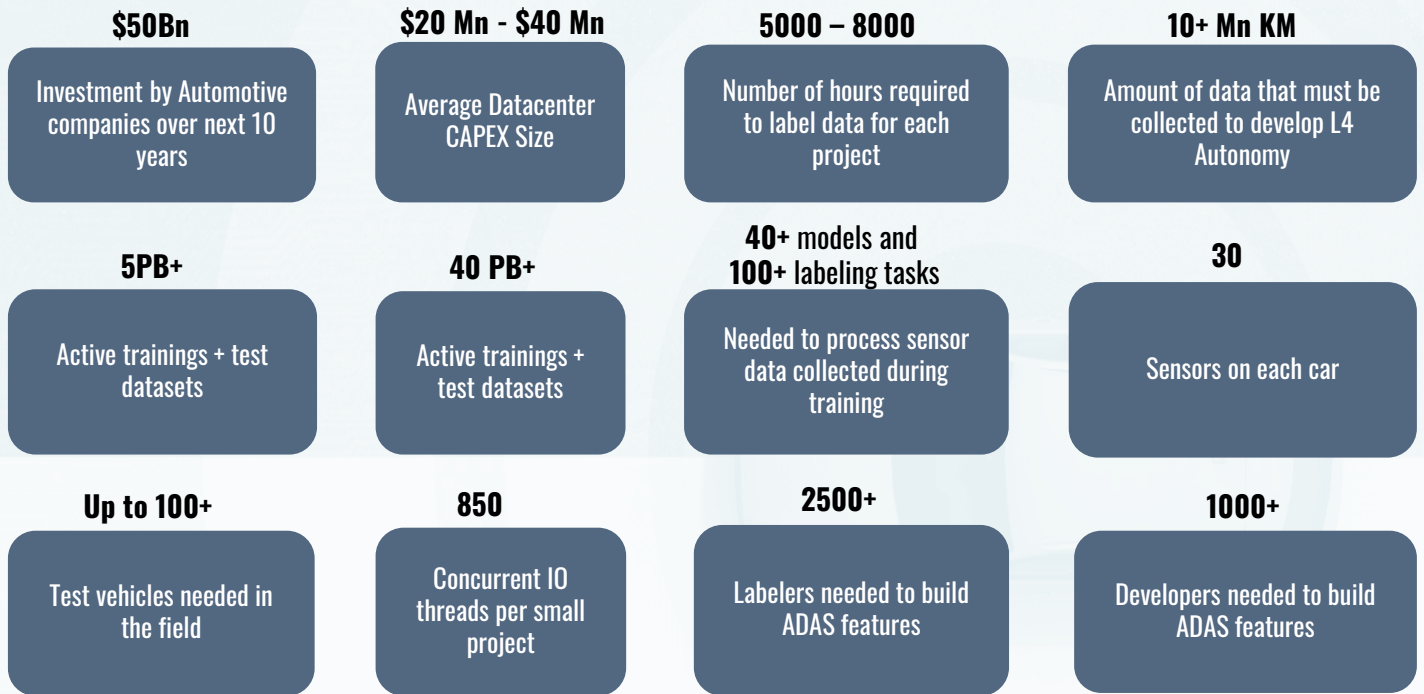
$50Bn	**$20 Mn - $40 Mn**	**5000 – 8000**	**10+ Mn KM**
Investment by Automotive companies over next 10 years	Average Datacenter CAPEX Size	Number of hours required to label data for each project	Amount of data that must be collected to develop L4 Autonomy

5PB+	**40 PB+**	**40+** models and **100+** labeling tasks	**30**
Active trainings + test datasets	Active trainings + test datasets	Needed to process sensor data collected during training	Sensors on each car

Up to 100+	**850**	**2500+**	**1000+**
Test vehicles needed in the field	Concurrent IO threads per small project	Labelers needed to build ADAS features	Developers needed to build ADAS features

Figure 1: Planning for the Future Needs of ADAS/AD

2 Extensive ADAS Expertise: Development, Deployment, Delivery Services

Whether you're looking for advice on infrastructure requirements or a complete end-to-end solution including tools, infrastructure, and engineering personnel, the solution offered by Dell Technologies and Tech Mahindra offers a comprehensive solution. There are many vendors today that offer various tools and services for ADAS/AD development, but few if any offer end-to-end solutions that are truly open. The Dell Technologies and Tech Mahindra Autonomous Drive ecosystem represents just such a solution. Our development ecosystem is both comprehensive and open, and extends to provide a roadmap of stable, industry-proven solutions that bring together Dell's leading-edge infrastructure, Tech Mahindra's comprehensive ADAS/AD design and project management services, with specialized software from an extensive ecosystem of industry-proven automotive partners. With our combined resources and experience, you have the flexibility to adopt only the tools, services and/or infrastructure (public and/or private) that you need.
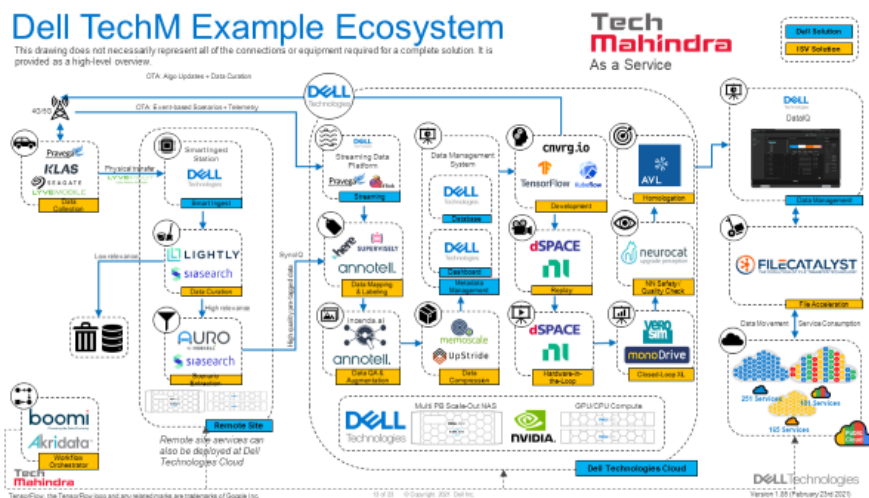
3 Typical ADAS/ AD Development Workflow

Companies focused on autonomous vehicle (AV) and ADAS development require extensive computing resources to accelerate the development process and get vehicles with new ADAS features on the road. Tech Mahindra and Dell Technologies have joined forces to streamline the ADAS/AD workflow. This heat map of the ADAS/AD development workflow represents our ability to provide a comprehensive solution that covers all three key areas (data storage, networking, computing) of AD/ADAS development.

Car build-up → Sensor Integration → DAQ System → In-Car Compute → Recording Planning → Recording Campaigns + Sys Mgmt

Data Management ← Data Ingestion ← Data Cleaning and Compression ← Data Quality Check ← Context Labeling ← Data Qualification

Metadata Management → Data Enrichment Planning → Data Enrichment → ADAS / AD Product Development → Algorithm Training → Re-Simulation

Start of Production ← Disaster Recovery ← Backup Management ← Quality assurance ← HiL, SiL, MiL ← Synthetic Simulation

Legends: ▬ Dell Hardware or Software   ▬ Tech Mahindra capabilities   ▬ Customer

4 Future-proof and Software-defined

The automotive industry manages uncertainty by planning the entire lifecycle of the vehicle – from the concept and design stages of development to detailed simulation, testing, production, homologation, and long-term support. However, consumer preferences are dynamic, so OEMs and suppliers must have greater flexibility to meet changing consumer demands. That requires open standards and vendor interoperability with existing solutions as well as new ones. The underlying data infrastructure must be future proof and software defined. That too must be flexible, performant, and scalable to meet unknown and unbounded future growth rates. This is the foundation of the Autonomous Drive ecosystem – the matching of open technologies with an equally open and future proof infrastructure that is ready for wherever the market leads you.

5 Worldwide Enterprise-ready and Cloud-enabled

Advanced safety solutions of today, and most certainly fully autonomous vehicles of the near future, must be developed to adapt to regional variations in local languages, culture variations, signage, laws, security, and privacy. ADAS / AD development is a global project that requires support and services from partners with global reach. Whether ingesting sensor data in a local garage, consolidating that data in one of many regional data centers, either on-premise or co-located, Dell Technologies and Tech Mahindra can provide you with the right infrastructure. Dell Technologies can also help you with your public cloud journey, assuring you maintain access to tools and services, while enabling you to maintain data security, flexibility, and portability. Automotive development services, including regional test vehicle staffing and management, data logistics (cartridge collection and ingest), artificial intelligence (AI) algorithm development, testing services, and full program management – to name a few – are also available worldwide. Many organizations face administrative and logistics challenges when installing and managing data centers worldwide. Tech Mahindra helps with set-up, management and upgrades to datacenters of all sizes in all major countries in the world.

6 Edge-to-Core-to-Cloud

Cars of today are already packed with electronics, and with increasingly sophisticated ADAS / AD and vehicle electrification on the horizon, the dependence on connectivity will only grow. Whether in development or production, vehicles will be generating data constantly, and the need to process that data for safety purposes, both in real-time, as well as for the long haul (measured in decades), will only grow.

Up-front planning for the data lifecycle is critical. With our experience and world-wide industry knowledge, Tech Mahindra and Dell Technologies can help you architect a solution that meets your immediate needs as well as preparing for future needs. Real-time data streaming and analytics will create yet-to-be-identified new revenue opportunities across the supply chain, so the need for future-proofing the underlying architecture becomes more critical. Dell Technologies and Tech Mahindra understand this and provide some of the most flexible solutions for building and scaling your data lake – and extending it to include edge computing, real-time streaming analytics and multi-cloud support.
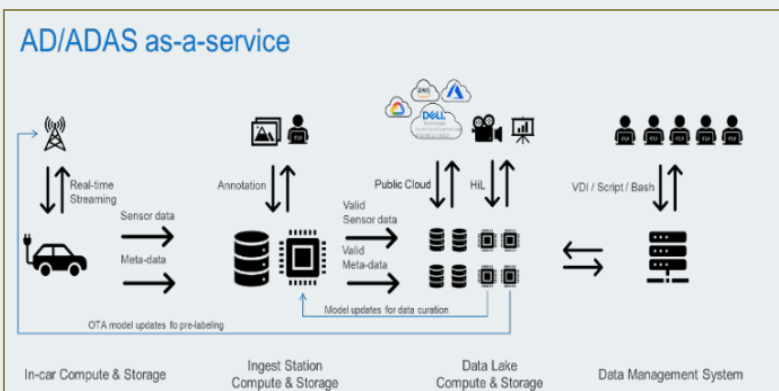
END-TO-END ADAS / AD SERVICES

Data Center
- Infra sizing & consulting
- GPU + CPU Processing stack
- Hot and Cold Storage
- Vehicle data collection & In vehicle storage

Data Management
- Data Management
- Data lake & Orchestration
- Workflow management
- Image, Video, Lidar and Radar
- Automation for workflows

Development
- Annotation
- Mapping
- IN-vehicle applications
- Middleware, OS
- Model Based Design & Development
- Simulation
- AI/ML/RL
- Vehicle training

Test & Validation
- Regression testing
- SIL Testing
- MIL Testing
- HIL Testing

Integration
- AUTOSAR
- Steering & Actuation
- Vehicle integration and Engineering

7 Proven ADAS Infrastructure Solutions

Data management is key to any ADAS / AD Development program. SAE level 3 ADAS solutions typically require 50 to 110 PB of sensor data. As the industry progresses towards level 5 fully autonomous vehicle development, data is expected to grow into the exabyte range. This data is used for everything from AI algorithm development to software- and hardware-in-the-loop (SiL/HiL) testing, which require considerable processing power. An infrastructure architecture that is designed to grow with the project, including CPU / GPU resources as well as the management of data for the decades-long life of the vehicle is critical. This is where Dell EMC PowerScale network attached storage, along with Dell EMC PowerEdge CPU and GPU servers, rise to the task. Approximately 70% of ADAS / AD tier-1 developers already depend on Dell EMC PowerScale storage today.

8 Comprehensive Automotive Portfolio

Partnering with Dell Technologies and Tech Mahindra means that you have ready-to-use solutions that go beyond ADAS/AD. We provide engineering services as well as corresponding infrastructure (workstations, laptops, networking solutions), electronics and software design (infotainment, body electronics, battery management, and more.), mechanical design and simulation (suspension, braking, engine, transmission and drive train). We also offer expertise and solutions across smart factories (edge devices, streaming data management, digital twin, algorithm development and maintenance, and so on), OEM solutions (for dealer diagnostics computers, ruggedized handhelds), and connected cars (fleet management, electronics design, edge computing and data management solutions).

01 — System Engineering & SW Development
- Requirement Engineering
- SW Architecture Definition
- HMI & Business Logic Development
- Platform Infrastructure Development
- 3rd Party Module Integration
- Middleware – CAN, LIN, FR
- Diagnostic & Bootloader Dev.
- OS Experience – QNX, Integrity

02 — Verification & Validation
- Test Definition
- Test Infrastructure Establishment
- Code Quality Check
- Test Automation Framework – Instrument Cluster/ Infotainment
- Unit Test – SSIT, Code Coverage
- Integration Test – HIL, SIL, HSIT
- Reliability & Acceptance Test
- Environmental Test

03 — Model Based Development
- Control Algorithm Development
- Legacy Code to Model Migration
- Auto Code Generation
- MBD Best Practise
- Integration of Codes

04 — AUTOSAR
- Migration from Legacy Code
- BSW Module Development Configuration & Integration
- MCAL Driver Development
- Integration as Service
- Complex Device Driver Development
- Application Specific Diagnostic Service implementation & Integration

05 — Functional Safety
- Safety Plan, Hazard Analysis & Risk Assessment
- Requirement Derivation FSR/TSR
- FMEA, FTA – System HW, SW
- ISO26262/ SOTIF Complaint Product Dev
- Traceability, Architectural Metrics
- HW/SW Testing – Verification of Safety Requirement
- Safety Case Doc Preparation
- Certification Assistance

06 — Mech Design & Simulation
- System Engineering
- Concept Definition & Simulation
- Schematics & Layout Design
- Devp & Manufacturing Feasibility Checks
- Weight, Cost Target Definition
- Alternate Material & Process Identification
- Dimensional Management
- Prototype Development
- Physical Validation

07 — ECU Hardware Engineering
- EE Architecture Definition
- ME Design Analysis & Simulation
- Worst Case Analysis
- Reliability Production
- Block Level FMEA
- Circuit Simulation & Worst-Case Analysis
- Thermal, SI EMC Analysis
- DFM, DFT

08 — Product Sustenance
- VAVE
- Obsolence Management
- Product Upgrade
- Product Documentation
- Product End of Life Management

Figure 2: Tech Mahindra's Automotive solutions and Services portfolio

Authors

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Prashant comes with 20 years of experience in Automotive industry. He is currently working as CXO Advisor | Global Digital Practice Lead – Smart Products, developing capabilities in evolving technologies and enabling Tech Mahindra's customers developing ADAS, Autonomous driving technology, V2X, Connected Products etc. He brings expertise on IT and Infrastructure technology application in R&D domain. including Engineering Cloud, Engineering data and analytics, Application of Machine learning in Design and development. He is reachable at Prashant.khairnar@techmahindra.com

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