IBM Data Management for ADAS Introduction

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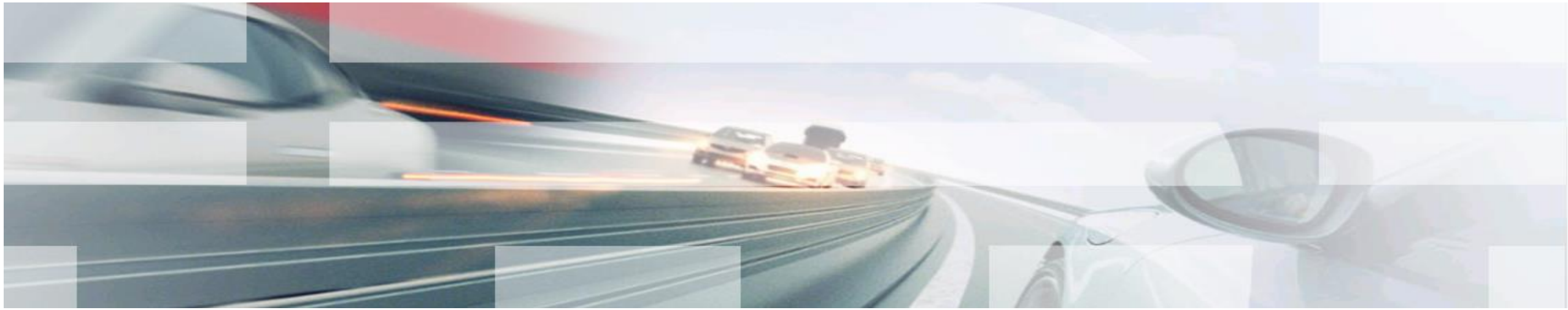
March 2018 v18



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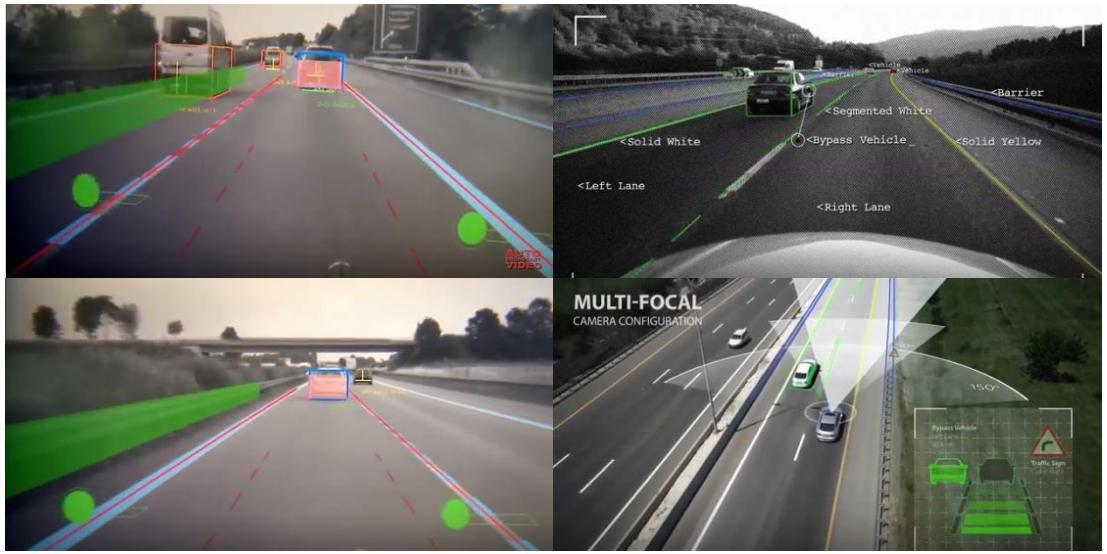
Automotive Industry generates large amounts of data

- Storage of data (sensor / video) is very costly.
- Handling of these data is difficult i.e. due to high required bandwidth.
- For testing purposes sensor / video data are much more complex in comparison to discrete bus signals, electronic values, etc.



Sources: Images from https://www.youtube.com/watch?v=4jW0fJ80VG8
https://www.youtube.com/watch?v=dhEgD6ZFlQE
https://www.youtube.com/watch?t=21&v=39QMYkx89j0

- Sensor / video data must be synchronously captured, stored, modified and executed with other testing data such as CAN, FlexRay, Radar, LiDAR, HiSonic, etc. – most common format is **ADTF** from Elektrobit followed by **rtMaps** from Intempora and others like **MDF** etc.

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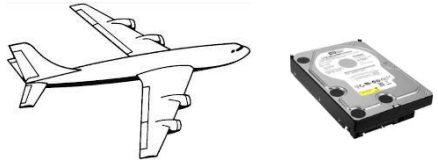
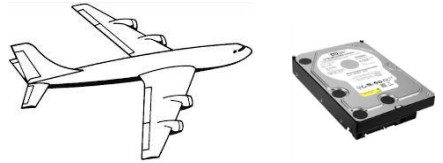
Data Management for ADAS/AD development and test is challenging

Test Drives

50-70TB / day / car



R&D Lab: tagging



R&D Labs: developing & testing

> 5PB / car model (project)

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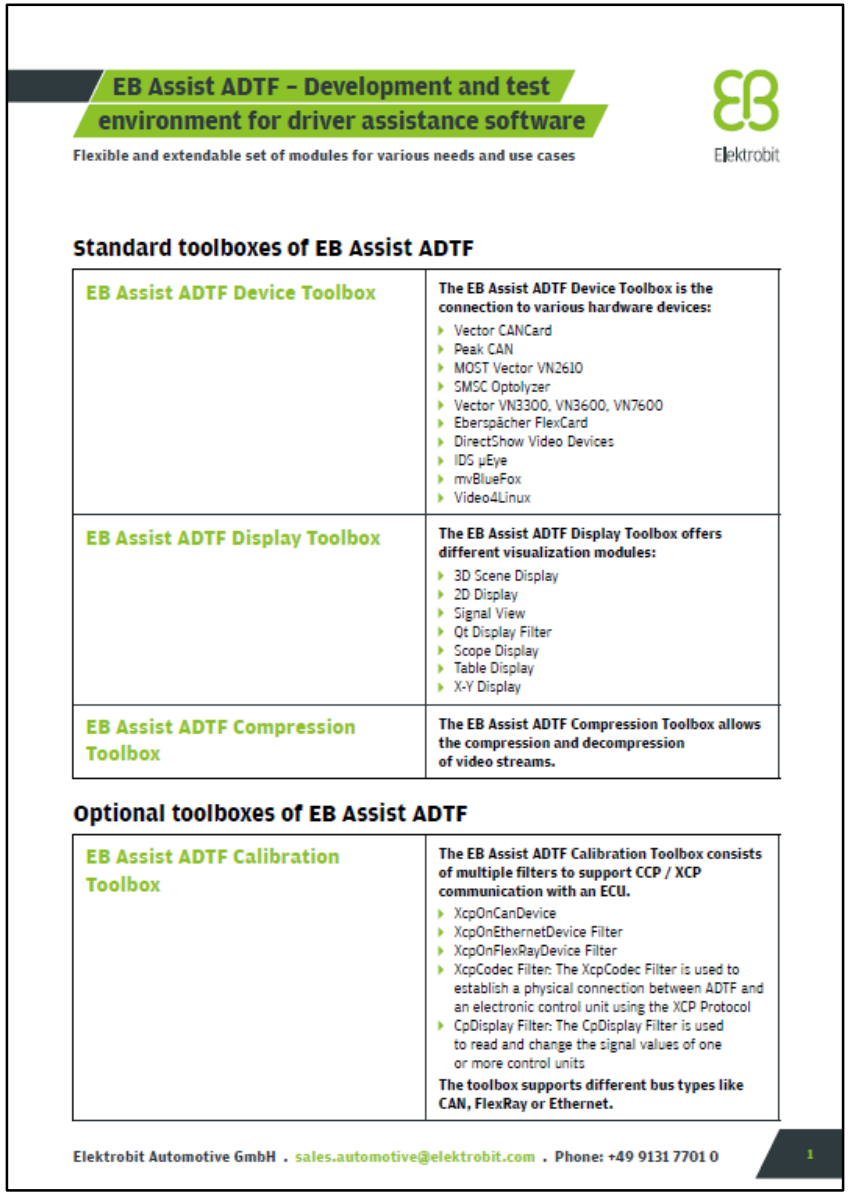
Automotive **D**ata- and **T**imetriggered **F**ramework

ADTF (Official name: EB Assist ADTF; Automotive Data- and Timetriggered Framework) has established itself as one of the de-facto standard of measurement software.

ADTF is designed to process data of various sources (CAN, video, flexray, and much more) synchronously. In addition of data recording and data playback, ADTF is capable to visualize them accordingly. “

https://www.elektrobit.com/products/eb-assist/adtf/



EB Assist ADTF – Development and test environment for driver assistance software

Flexible and extendable set of modules for various needs and use cases

Elektrobit

Standard toolboxes of EB Assist ADTF

EB Assist ADTF Device Toolbox	**The EB Assist ADTF Device Toolbox is the connection to various hardware devices:** Vector CANCard Peak CAN MOST Vector VN2610 SMSC Optolyzer Vector VN3300, VN3600, VN7600 Eberspächer FlexCard DirectShow Video Devices IDS µEye mvBlueFox Video4Linux
EB Assist ADTF Display Toolbox	**The EB Assist ADTF Display Toolbox offers different visualization modules:** 3D Scene Display 2D Display Signal View Qt Display Filter Scope Display Table Display X-Y Display
EB Assist ADTF Compression Toolbox	**The EB Assist ADTF Compression Toolbox allows the compression and decompression of video streams.**

Optional toolboxes of EB Assist ADTF

EB Assist ADTF Calibration Toolbox	**The EB Assist ADTF Calibration Toolbox consists of multiple filters to support CCP / XCP communication with an ECU.** XcpOnCanDevice XcpOnEthernetDevice Filter XcpOnFlexRayDevice Filter XcpCodec Filter: The XcpCodec Filter is used to establish a physical connection between ADTF and an electronic control unit using the XCP Protocol CpDisplay Filter: The CpDisplay Filter is used to read and change the signal values of one or more control units **The toolbox supports different bus types like CAN, FlexRay or Ethernet.**

Elektrobit Automotive GmbH . sales.automotive@elektrobit.com . Phone: +49 9131 7701 0

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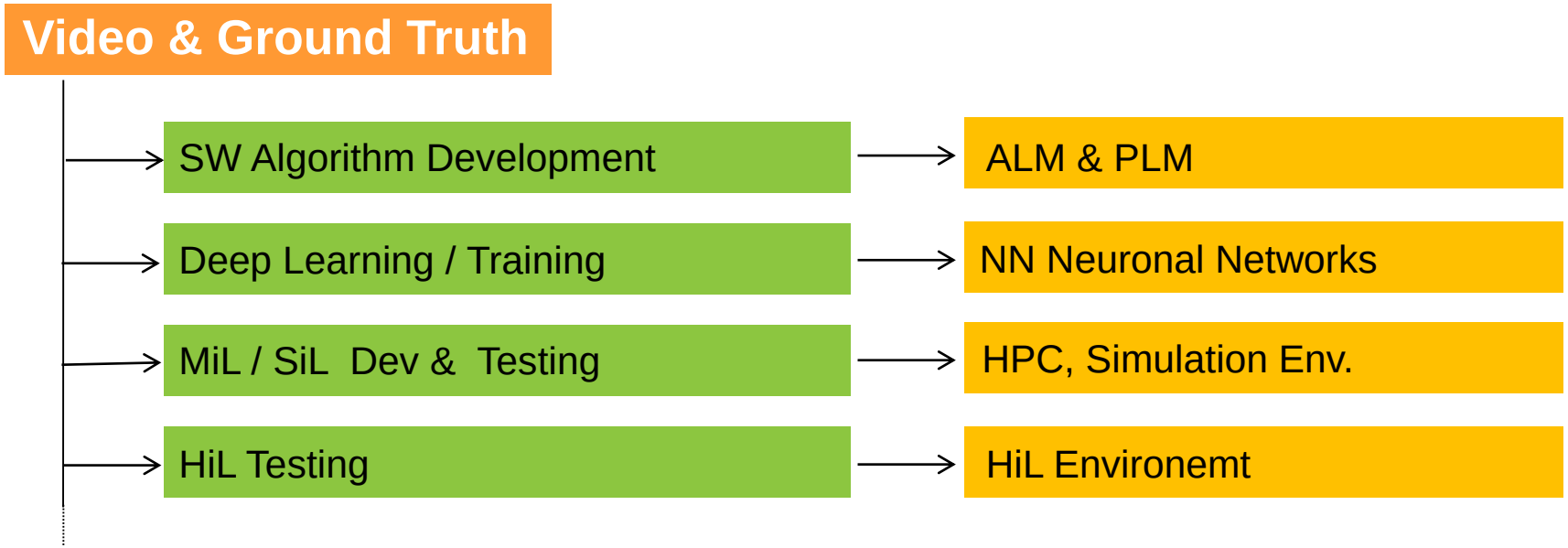
Data is used in various ADAS/AD development and testing processes and touch many existing systems



Mostly under the process and methods constrains of Automotive SPICE and ISO26262

AUTOMOTIVE SPICE®

ISO 26262

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Convergence of Machine Learning and Artificial Intelligence towards enabling AD

MIT Boston, March 24th 2017 - Brains, Minds, and Machines Seminar Series:
Prof. Dr. Amnon Shashua, Hebrew University, Co-founder, CTO and Chairman of Mobileye

https://youtu.be/b_lBL2yhU5A

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Who's Who in the ADAS/AD World (https://www.visionsystemsintelligence.com)

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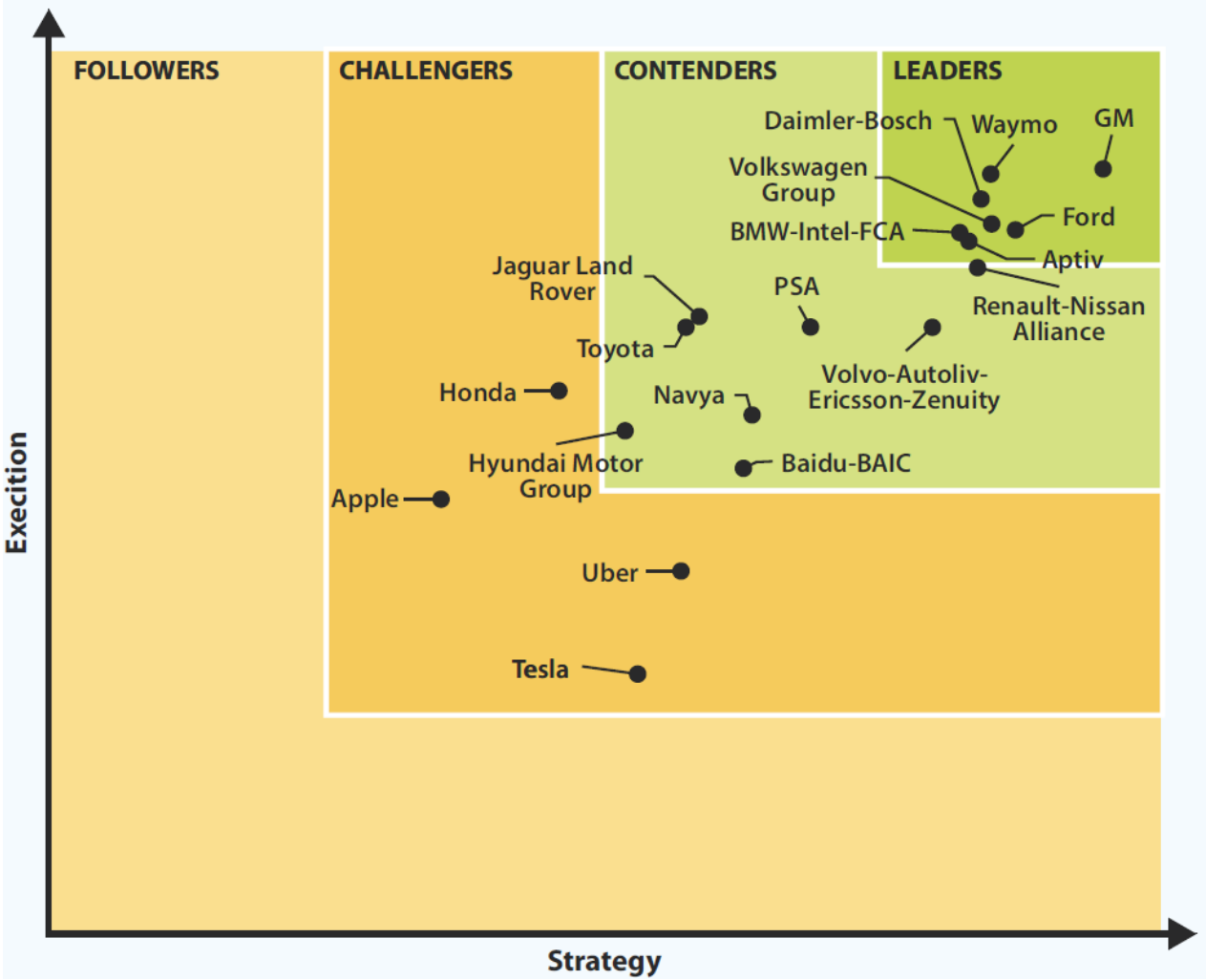
Overview of ADAS Players (12/2017)

Strategy and execution assessed for 19 companies developing automated driving systems.



Report Details

Price: Login to view

Pages: 64

Tables, Charts, Figures: 25

Release Date: 1Q 2018

Release File(s): PDF* and Excel

*Indicates primary report file.

Press Releases:

GM, Waymo, and Daimler-Bosch Are the Top 3 Leading Companies Developing Automated Driving Systems

Other Companies to Watch

- Aurora Innovation
- AutoX
- Comma.ai
- Didi
- drive.ai
- Embark (Previously Varden Labs)
- FiveAI
- Lyft
- Magna International
- May Mobility
- Nauto
- Next Future Transportation
- Nuro.ai
- Valeo
- Voyage
- ZF Friedrichshafen AG
- Zoox

https://www.navigantresearch.com/research/navigant-research-leaderboard-automated-driving-vehicles

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The IBM ADAS Solution Approach

1. How to implement & operate an efficient storage, workflow and management system?

„The Foundation“

2. How to distribute data globally within an enterprise and partners?

3. How to preserve digital data for decades with optimized costs?

4. How to analyze sensor and video data with fast analytics and modern BD tools?

5. How to run Machine Learning (ML) and AI training with Nvidia GPU technology at scale?

6. How to do efficient IT workload and resource scheduling?

7. How to embed analytics/data management into R&D Environment?

8. How to run massive workloads on large topology Clusters with data centric workloads?

IBM Spectrum Scale

Cloud Object Storage

IBM AREMA

IBM High-Speed File Transfer
IBM Aspera / Mass Data Migration

IBM Archiving
IBM Spectrum Protect

IBM Analytics

Hortonworks HDP, DSX, Spark, Crail

IBM Enterprise-Class AI

TensorFlow, AC922, Nvidia V100, PowerAI

IBM Spectrum Computing

IBM ALM & PLM Solutions
IBM Continuous Engieering

IBM Cloud Platform (Public)
Performance, scalability and costs.

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The IBM storage architecture based on Spectrum Scale, COS and Tape

IBM Spectrum Scale (HOT)

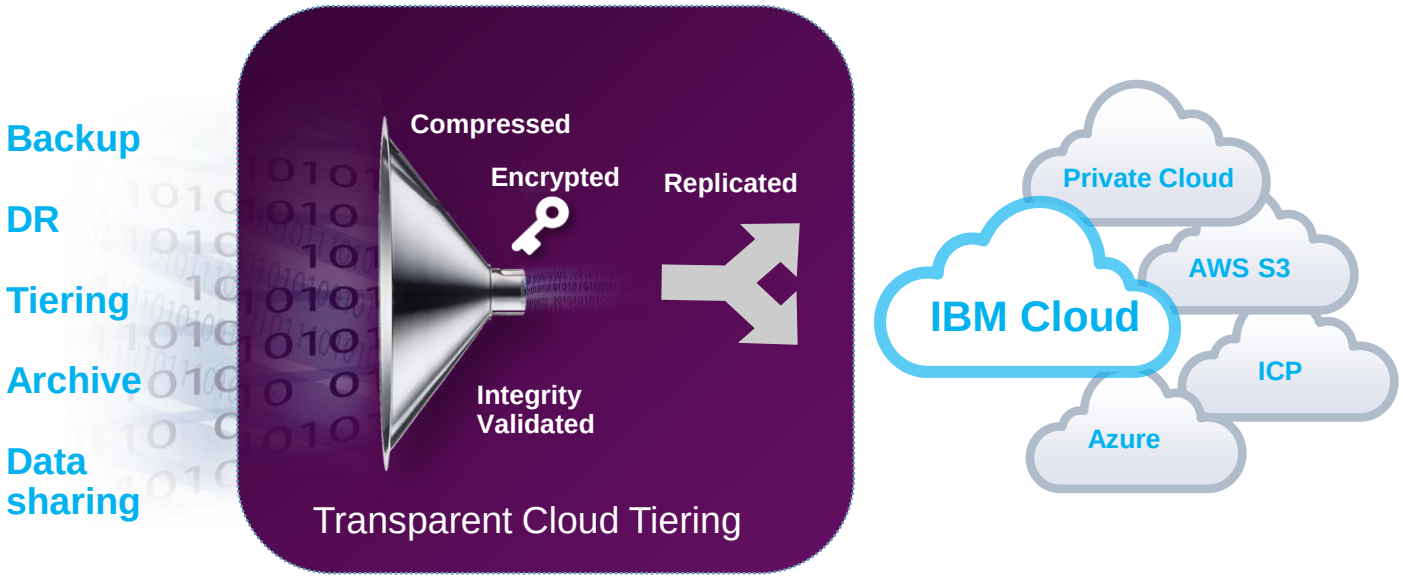
- File based storage with Object & HDFS support
- High End I/O performance
- Information Lifecycle Management (ILM)
- Sub Micro-seconds access time

IBM Cloud Object Storage (S3) (WARM)

- Site Fault Tolerant
- Geo Dispersed and WW scale
- Easy to Deploy
- Milli-seconds access time

IBM Spectrum Archive & Tape (COLD)

- Lowest TCO
- Tape ILM target – especially frozen archive
- Long term retention and Minutes access time
- Access as files via LTFS
- Reduced floor space requirements and energy consumption
- Up to 260PB native capacity in a single Tape Library



- Tiering from flash, to disk, to tape, to cloud.
- Cloud appears as external storage pool.
- Auto Tiering & migration.
- High performance Read/Write operations.
- Public cloud-ready.
- Support of multi cloud environments.

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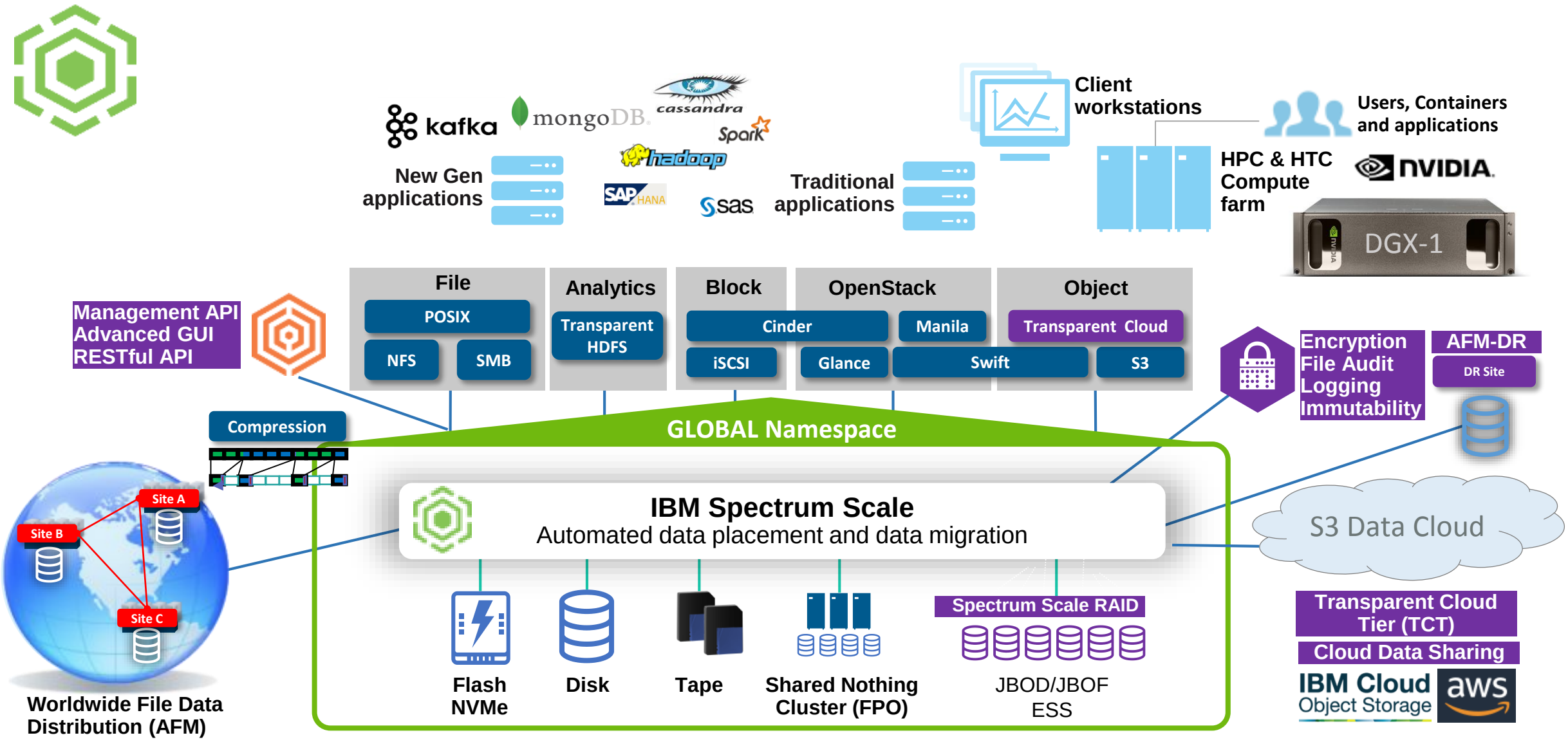
Building-block ”HOT” High Performance I/O File Storage



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IBM Spectrum Scale @ Automotive Tier-1 for HiL performance optimization

Elektrobit

PoC Result:

We demonstrated our ability to decrease Elektrobit HiL testing time needed for ADAS/AD workloads more than **a third** vs DellEMC Isilon based NAS.

SVA

Das PoC Ergebnis

System	Protokoll	Single File Copy	Single File Processing	Single File Gesamt	1000 Files	Differenz zum Bestand in Std.
Bestand	SMB 2.1	3 Minuten	5 Minuten	8 Minuten	8.000 Minuten	0
ESS / CES	SMB 2.1	2,5 Minuten	5 Minuten	7,5 Minuten	7.500 Minuten	8 Stunden
ESS / CES	SMB 3.0	1 Minuten	5 Minuten	6 Minuten	6.000 Minuten	33 Stunden
ESS / CES	GPFS	-	5 Minuten	5 Minuten	5.000 Minuten	50 Stunden

Save 50 hours processing time for HiL testing suite of 1000 video files.

22 11.03.2016

Proof of Concept (PoC) with IBM Business Partner SVA, Elektrobit (HiL) and a German Tier-1 supplier showed very encouraging results in using IBM Spectrum Scale instead of existing NAS filers.

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IBM Cloud Object Store (S3) – (WARM)

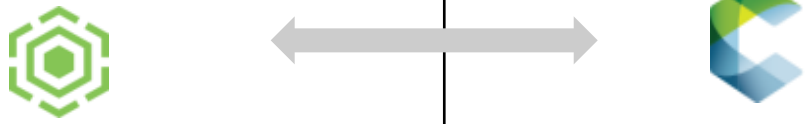
Idea: „Combine the best of both worlds.“

Object Storage definition:

a massively scalable, simple to manage storage technology that uses logical constructs to store data as discrete objects in a flat address space instead of the hierarchical, directory-based file systems.

https://www.ibm.com/cloud/object-storage

FILE STORAGE	OBJECT STORAGE
• Stores billions of files	• Stores billions of objects
• Optimum Performance	• Optimum Price
• File system hierarchy	• Scales uniformly
• Full POSIX Support	• S3 protocol API
• NAS protocol support	• Geo dispersed
• Best for file based workflows	• Cloud native App support
• Best I/O Performance	• High Latency access
• Low Latency access	



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Introducing a Fast, Simple Way to Transport Data to the IBM Cloud

- Designed for durability and ruggedness, Mass Data Migration portable storage devices have a useable capacity of **120 TB** and feature industry-standard **AES 256-bit encryption** to ensure that data is well protected during transport and ingestion.
- Each device also uses **RAID-6**, a premiere standard in redundancy and protection to ensure data integrity.
- Using a simple process, customers copy their data to the device and ship it back to IBM, where the data is offloaded to **IBM Cloud Object Storage** for use across the IBM Cloud platform.

https://www.ibm.com/blogs/think/2017/09/ibm-cloud-mdm/
https://www.ibm.com/cloud/mass-data-migration

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Building-block **”COLD”** Tape Storage

TAPE $AVES: COST • ENERGY • DATA • COMPANY

	2008	2011	2014	2017			
TS1100 Generations	**TS1130**	**TS1140**	**TS1150**	**TS1155**	**TS1160**	**TS1165**	**TS1170**
New Format Capacity (Native)	**1 TB (JB)** **640 GB (JA)**	**4 TB (JC)** **1.6 TB (JB)**	**10 TB (JD)** **7 TB (JC)**	**15 TB (JD)**	**18-20TB (JE)** **15-17 TB (JD)** **10-12 TB (JC)**	**~30 TB (JE)** **15-17 TB (JD)** **10-12 TB (JC)**	**30-40 TB (JE)**
Other Format Capacities (Native)	**700 GB (JB)** **500 GB (JA)** **300 GB (JA)**	**1 TB (JB)** **700 GB (JB)** **(All JA R/O)**	**4 TB (JC)**	**7 TB (JC)** **4 TB read only (JC)**	**10 TB (JD)** **7 TB (JC)** **4 TB (JC)**	**TBD**	**18-20 TB (JE)** **15-17 TB (JD)** **10-12 TB (JC)**
Native Data Rate	**160 MB/s**	**250 MB/s**	**360 MB/s**	**360 MB/s**	**Up to 500 MB/s**	**Up to 500 MB/s**	**Up to 1000 MB/s**

IBM Spectrum Archive

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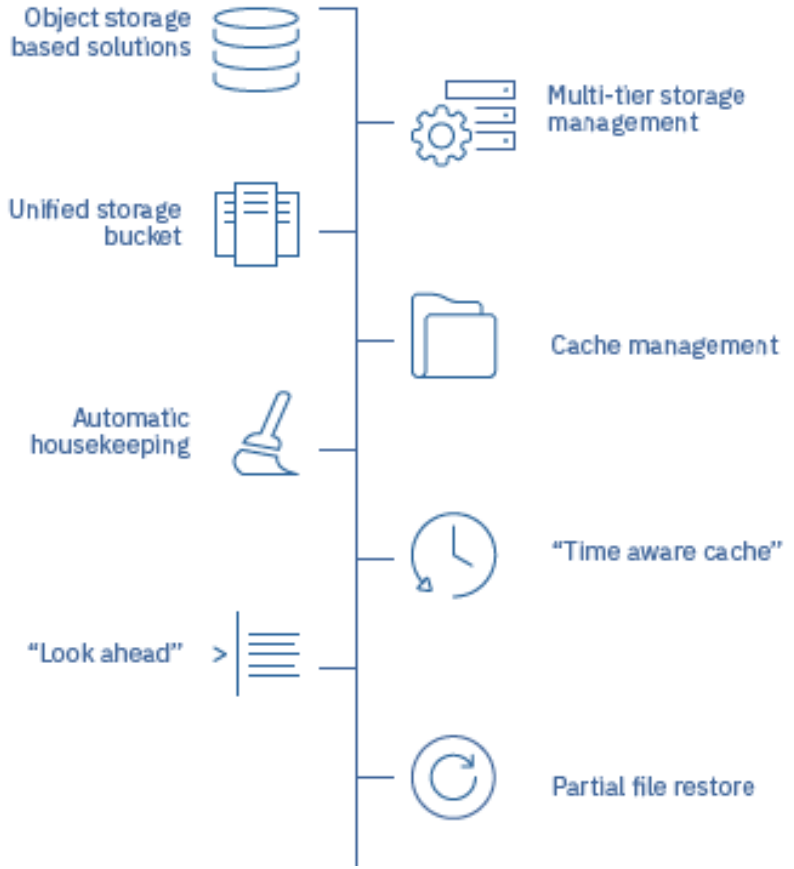
IBM AREMA – Workflow Orchestration for ADAS

- **IBM ARchive and Essence MAnager (AREMA)** is a well-tested solution in the media industry, used at many broadcasters with a very high market coverage.
- AREMA offers a workflow orchestration around media files with more than 150 media services for transporting, transforming and manipulating media files.
- Orchestrates external systems, e.g. IBM Aspera and video recognition plus tagging solutions, cloud and others.
- AREMA is a middleware and integration software – connecting different IT systems, works as bridge between multiple systems.
- AREMA is adapted to the automotive ADAS/AD testing needs.
- More information can be found here:

https://www-935.ibm.com/services/us/gbs/media-asset-management/

IBM AREMA



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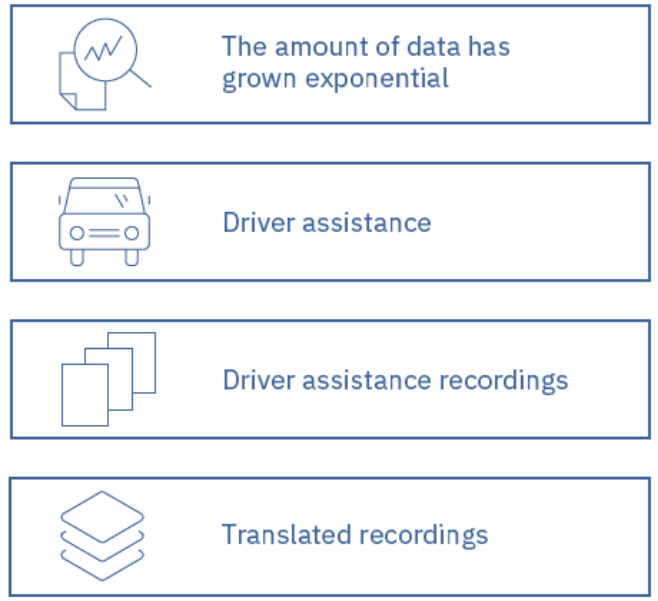
IBM AREMA – Workflow Orchestration for ADAS

IBM AREMA

- Cameras can capture large amounts of information easily, and are used as highly complex sensors in many scenarios, such as testing ADAS/AD.
- Audiovisual signals require very sophisticated analytics and are difficult to handle in today‘s workflows.
- AREMA supports various automotive formats (**ADTF, MDF or rtMAPS**) that are used to extract video and metadata from DAT files recorded via in-car cameras and Controller Area Networks (CAN bus).
- This enables the building of workflows to capture, store, modify and execute video data synchronously with other such testing data. It also supports functions like CAN message filtering or GPS message interpretation.
- AREMA connects to and integrates cognitive services for trainable advanced analytics. At the same time, AREMA manages storage environments by integrating on premise storage for production and archiving, as well as off premise cloud object storage environments.



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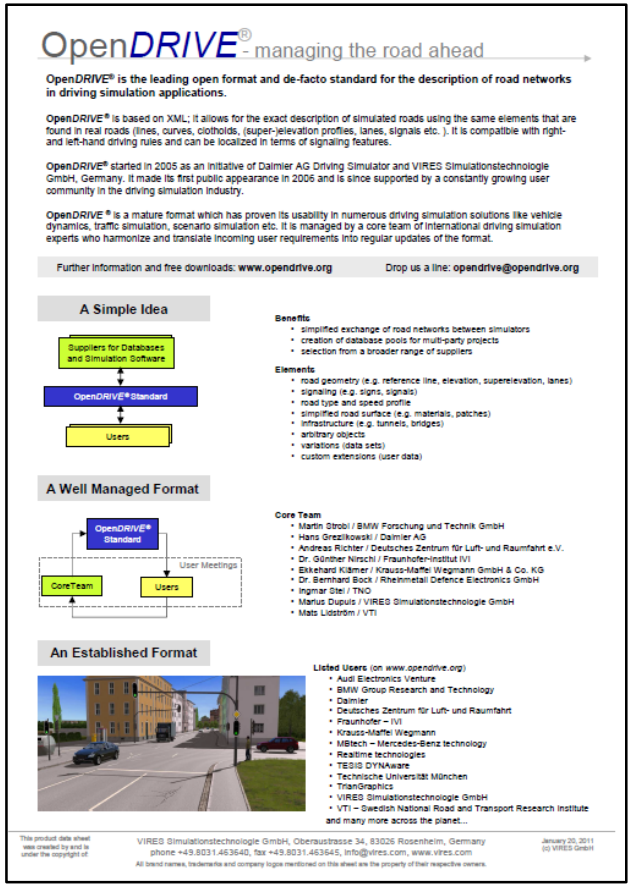
OpenDRIVE and OpenSCENARIO

OpenDRIVE is an open file format for the logical description of road networks. It was developed and is being maintained by a team of simulation professionals with large support from the simulation industry.



OpenDRIVE® - managing the road ahead

OpenDRIVE® is the leading open format and de-facto standard for the description of road networks in driving simulation applications.

OpenDRIVE® is based on XML; it allows for the exact description of simulated roads using the same elements that are found in real roads (lines, curves, clothoids, (super-)elevation profiles, lanes, signals etc.). It is compatible with right- and left-hand driving rules and can be localized in terms of signaling features.

OpenDRIVE® started in 2005 as an initiative of Daimler AG Driving Simulator and VIRES Simulationstechnologie GmbH, Germany. It made its first public appearance in 2006 and is since supported by a constantly growing user community in the driving simulation industry.

OpenDRIVE® is a mature format which has proven its usability in numerous driving simulation solutions like vehicle dynamics, traffic simulation, scenario simulation etc. It is managed by a core team of international driving simulation experts who harmonize and translate incoming user requirements into regular updates of the format.

Further information and free downloads: **www.opendrive.org** Drop us a line: **opendrive@opendrive.org**

A Simple Idea

Suppliers for Databases and Simulation Software

OpenDRIVE® Standard

Users

Benefits
- simplified exchange of road networks between simulators
- creation of database pools for multi-party projects
- selection from a broader range of suppliers

Elements
- road geometry (e.g. reference line, elevation, superelevation, lanes)
- signaling (e.g. signs, signals)
- road type and speed profile
- simplified road surface (e.g. materials, patches)
- infrastructure (e.g. tunnels, bridges)
- arbitrary objects
- variations (data sets)
- custom extensions (user data)

A Well Managed Format

OpenDRIVE® Standard

User Meetings

CoreTeam

Users

Core Team
- Martin Strobl / BMW Forschung und Technik GmbH
- Hans Grezlikowski / Daimler AG
- Andreas Richter / Deutsches Zentrum für Luft- und Raumfahrt e.V.
- Dr. Günther Nirschl / Fraunhofer-Institut IVI
- Ekkehard Klämer / Krauss-Maffei Wegmann GmbH & Co. KG
- Dr. Bernhard Bock / Rheinmetall Defence Electronics GmbH
- Ingmar Stei / TNO
- Marius Dupuis / VIRES Simulationstechnologie GmbH
- Mats Lidström / VTI

An Established Format

Listed Users (on www.opendrive.org)
- Audi Electronics Venture
- BMW Group Research and Technology
- Daimler
- Deutsches Zentrum für Luft- und Raumfahrt
- Fraunhofer – IVI
- Krauss-Maffei Wegmann
- MBtech – Mercedes-Benz technology
- Realtime technologies
- TESIS DYNAware
- Technische Universität München
- TrianGraphics
- VIRES Simulationstechnologie GmbH
- VTI – Swedish National Road and Transport Research Institute

and many more across the planet...

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January 20, 2011
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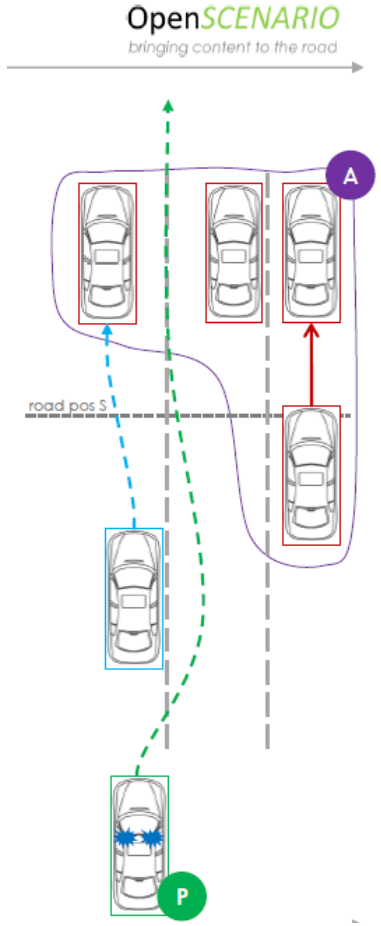
http://www.opendrive.org/

OpenSCENARIO is an open file format for the description of dynamic contents in driving simulation applications. The project is in its very early stage and will be made available to the public in the very near future.



http://www.openscenario.org/

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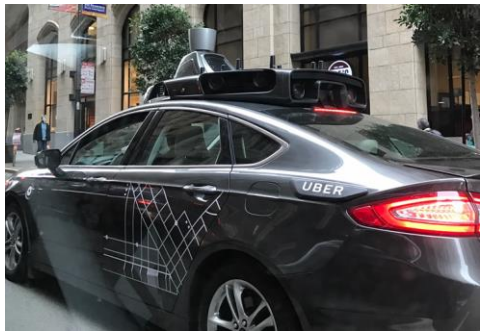
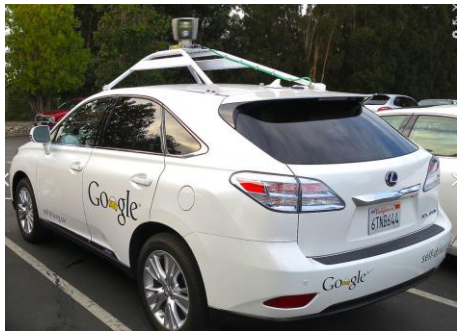
Executive Summary

IBM is uniquely positioned to address todays challenges in the automotive industry for development and testing, bringing together technology, assets and know-how from:

- The storage and archive landscape
- Data transmission, compression and encryption
- Essence management in the media industry
- Systems and software engineering in the automotive industry including High-Performance Computing (HPC), simulation and testing
- Application Lifecycle Management (ALM) and Product Lifecycle Management (PLM)
- Cognitive and AI computing

Thus helping automotive OEMs and Tier-1s to optimize current workflows and significantly reduce costs - for example in ADAS/AD related data management.





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