Feature Article

ASAM-ODS A Standardized Data Source for Test-bed Environments

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The diversity and incompatibility of heterogeneous data archives within automotive product development was one of the driving forces that led to the foundation of the Association for Standardization of Automation and Measuring systems (ASAM). For the last 18 years ASAM has developed standards for the domain of automotive powertrain product testing. The standard for archiving test result data is based on a metadata model with assigned semantics to its structure elements. Generic clients are able to browse through customer specific data structures and retrieve the data for post-processing.

Introduction

During the development of vehicles and vehicle parts, a huge mass of data is compiled. The problem arises to make the data accessible in a standardized manner, for post-processing tools. The standardization of data modelling and data retrieval was a big challenge for the automobile industry and their suppliers. The challenge was accepted by the ASAM consortium, which has developed during the past 18 years a mature solution for data archiving and retrieval in the domain of product testing. Today, the standard is available and the automobile car industry in Europe requests from its suppliers the implementation of this standard as part of their test bed automation systems.

Who is ASAM?

The ASAM organization was founded in the early 90's with the goal to develop software standards for product testing in the R&D domains of the car manufacturers. Originally ASAM started as a German initiative of car manufacturers and their suppliers. In the mid 90's all ASAM standards created so far were reviewed in the STAUMECS project (Standardisation of Automation, Measuring and ECU Calibration Systems) that was funded by the European Community as part of the AIT-Program. Fourteen European companies were involved in STAUMECS. These included automotive, aerospace and supplier companies as well as test equipment vendors. By the end of the 90's the ASAM community counted more than 100 companies from Europe, North-America and Asia. The original German initiative emerged within 18 years to become a worldwide consortium.

Today ASAM provides standards for data models, interfaces, and specifications for a variety of applications like data acquisition, data management, automated test runs and measurement data evaluation. In detail ASAM provides specifications for:

- ACI (automatic calibration interface), a remote control interface for test bed automation systems designed for engine calibration
- CEA (components for evaluation and analysis), a framework for analysis tools
- GDI (generic device interface), an interface for measuring devices
- AE (automotive electronic), interfaces and data structures for automotive electronics development and test processes
- ODS (open data service), a generic data model and an interface for data retrieval

HORIBA group companies, head office and Darmstadt office of HORIBA Europe GmbH in Germany were ASAM foundation members. Since the early days of ASAM, both companies have been deeply engaged in the ASAM working groups. Currently the author is the

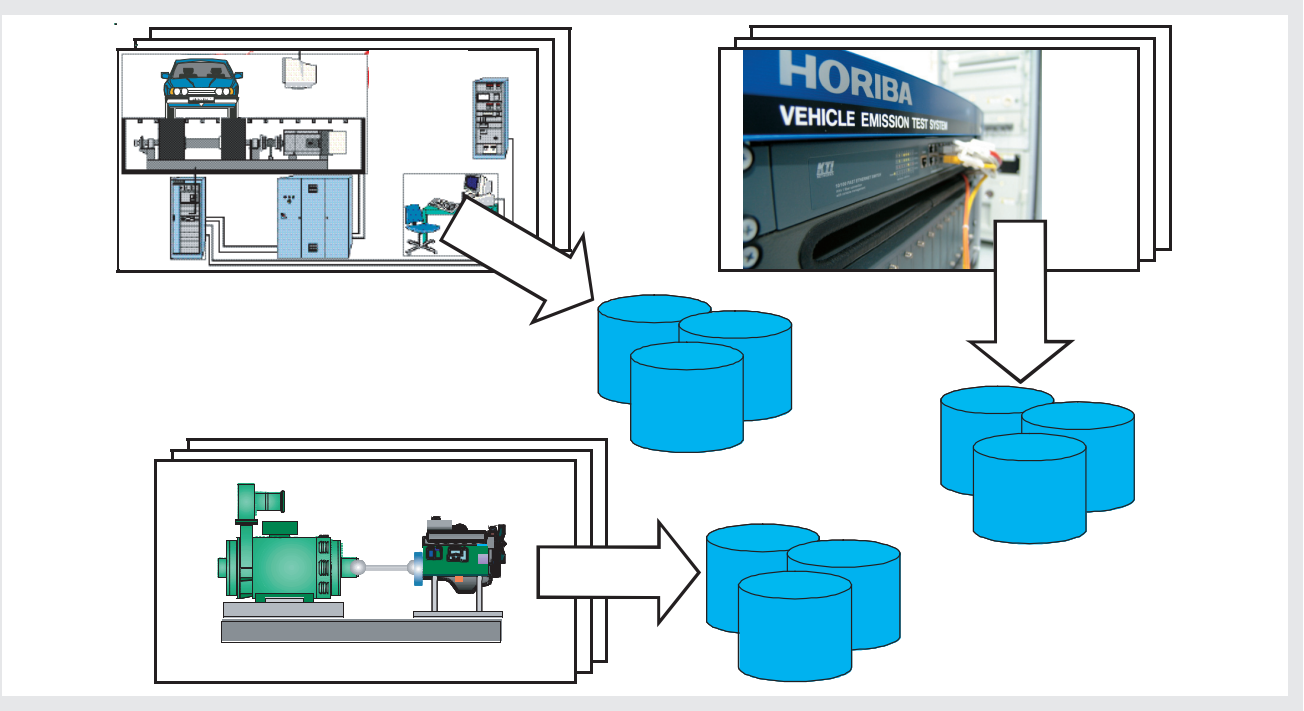

Figure 1 Customer Environment with Test Data Archives

speaker of the ACI working group and in parallel the ACI delegate for the ASAM Technical Advisory Board. This committee controls all technical projects and cooperates with the ASAM board of directors. During the annual membership meeting in 2007, Dr. George Gillespie from HORIBA Europe GmbH was elected as a new board member to the ASAM Board. Due to his experience and HORIBA's roots in Japan, he will support ASAM to extend activities in the Asian region.

Data Archive in a Customer Environment

The storage and retrieval of measuring data emerged as a rather crucial matter in the development departments at OEM site. The successful and efficient data retrieval supports decisively the strength and the power of any development team. For this reason the ASAM open data service (ODS) specification was chosen here and the concepts are outlined in the following chapters.

The importance of a standardized data archive will be explained by means of a simple but typical customer scenario (Figure 1).

In a customer test field we can identify a variety of test cells for dedicated test applications. Huge amounts of data covering the following topics are produced and archived:

- Descriptive data of the test environment (test stand, test specimen, workflow)
- Configurations of the test automation system
- Data measured during a test of an engine, a brake, exhaust gas after treatment system, etc.
- Calibration data for engine or vehicle parts

Historically the vendor of the test stand automation system supplied his own data evaluation tools operating on the proprietary data archive supplied as part of the automation system. However, today the situation has changed completely. Test stand automation systems must provide the test results in a standardized manner, to make the results accessible for third party evaluation tools. Such a standard is of extraordinary benefit for the customer as he is no longer depending on one supplier for test bed software components, nor is he depending on a specific supplier for evaluation tools. Now the customer can operate a diversity of analysis tools as well as a diversity of test bed automation systems and exchange a component from vendor A by a component from vendor B without disturbing the interoperability of his test system components. As a consequence, European customers expect the integration of the ASAM standards into the test equipment components.

The ASAM ODS Generic Data Model

At the very beginning the ASAM ODS working group was faced with the challenge, to develop a standardized archive that supports a diversity of applications that

reflect the broad range of customer requirements (e.g. test specimen structures, data sampling systems, individual unit system, test bed structures, workflow structures). To match the challenge, the ODS specification is distinguished by an essential design decision: the introduction of a meta-data model with a predefined semantic for each meta-model element. The meta-data model pre-defines a structure framework (Figure 2), additionally expressed by a set of rules. This framework is expandable to application specific customer data models. A client application, familiar with the meta-data model, the implicit assigned semantic to its elements and the underlying rules, is capable to navigate through any customer specific data structure and to retrieve the requested data.

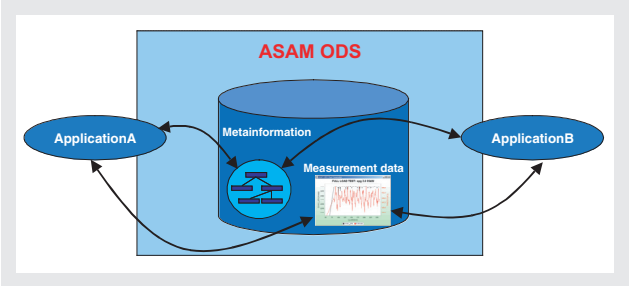

Figure 2 Meta-Information as Navigation Guide to Access the Measurement Data

Figure 3 represents a simplified view on the meta-data model, which is roughly subdivided into four groups for

- Administrative data
- Descriptive data
- Measuring data
- Quantities & units

The administrative data structures all test results into projects and subprojects as needed by the customer. The descriptive data are used to document the test context composed of a description about the test specimen, the test stand, and the applied test sequence. All these elements can be sub-divided into smaller parts if needed. It is possible to build a hierarchical structure to reflect the precise structure of a test specimen or the test stand details. The measuring data structure acts as glue, linking together all elements belonging to the same test run. The numeric measuring data are compiled in the "Data columns" with links to the associated measurement quantity descriptions and units.

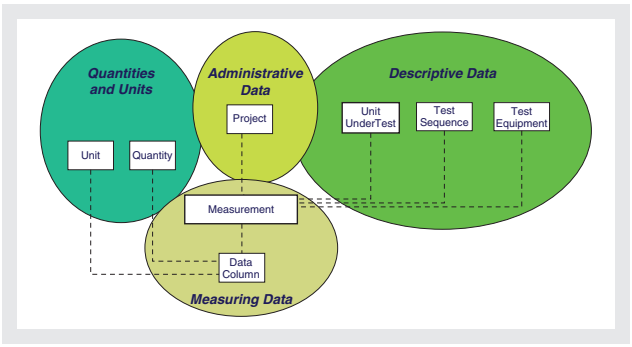

Figure 3 The ASAM ODS Base Model, Simplified

It can easily be recognized that it is impractical to standardize a unique data model suitable for all kinds of test applications with distinct test environments. Therefore the base model serves only as a template to derive specific data models as needed in a customer test application. Deriving a specific data model means that for each abstract element in the base model a concrete data element is defined. For example, the rather general element "Unit Under Test" which is a representative for any test specimen, is expanded to a concrete test specimen like a gasoline combustion engine. The expansion reflects the engine structure into its sub-components (spark, crankshaft, camshaft, valves, fuel supply system, cylinder, piston, etc), and if necessary, a sub-component can be split into further sub-components. Each component and all its sub-components are supplemented by attributes and attribute values. The links between the components, as pre-defined in the base model (Figure 3), are automatically inherited by the customer specific data model. If necessary the customer can define additional links.

The ASAM ODS Server Interface

The generic data model as described in the previous chapter is implemented in a component called ASAM ODS server. The ODS server is equipped with an application programming interface (API). This API is tailored according to the meta-data structure and provides groups of functions for querying, reading, writing data and configuring the data structure.

The physical data archive behind the API is hidden to the client application. The data archive can be a relational database like an SQL database or even a simple file farm. An ODS server is an application specific interface for a database, designed to operate in the domain of product testing.

The client applications and the ODS server are connected via a computer network (Figure 4). The free accessibility of the ODS server in a computer network requires an authorization system. Therefore, a user gaining access to the ODS server must identify himself/herself when opening a retrieval session. If he/she is not registered at the ODS server as a legal user, the opening of the retrieval session is denied. Moreover access rights for selected users can be assigned to parts of the ODS server content. This strategy supports the customer requirement, that users are authorized to access the ODS server but without extended access rights to dedicated test results will not be able to see confidential test data.

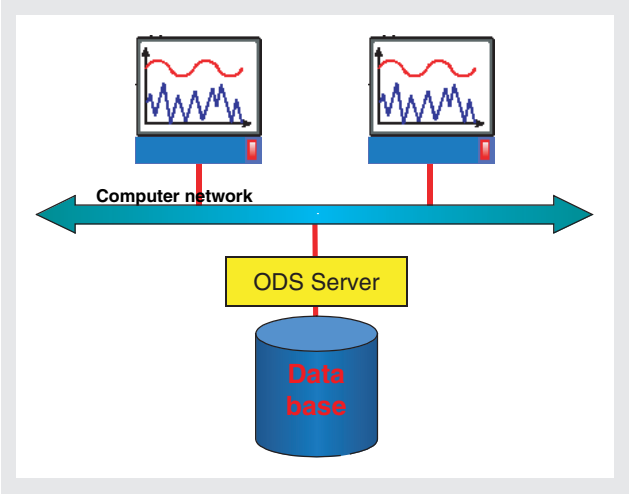

Figure 4 The ASAM ODS Server in a Computer Network Environment

ASAM ODS in Operation

In the meantime the integration of the ASAM ODS standard into the test stand automation software systems has become a matter of course especially in the European automotive market.

HORIBA has developed an ODS server as part of the STARS automation system that is already in operation at several customer sites. One customer is running a large number set of data evaluation tools from different vendors that are connected via the ASAM ODS interface with the STARS ODS server. The ASAM ODS standard proved to be of great benefit for the customer, because he/she could stick to the existing evaluation tool installations.

To verify and enhance the quality of software products with integrated ASAM ODS interface, the ASAM ODS working group is annually arranging a cross test, usually hosted by a car manufacturer. All ASAM members and suppliers of ASAM ODS products are invited to participate. A couple of months before the cross test event, the test schedule is distributed together with the applicable test data. So every participant has a fair chance to be well prepared for the test. HORIBA ATS joined this cross test with our STARS ODS server with two other ODS server providers. The client tool providers connected their products consecutively with the ODS servers and addressed commands to the servers as requested by the test schedule. It was verified, that our STARS ODS server was able to successfully cooperate with each of the clients.

Conclusion

The ASAM initiative has evolved within 18 years to become a worldwide association for the development of standards in the domain of product testing. The standard for archiving test results is based on a generic metadata concept as design decision to enable the navigation through customer specific data structures. Today European customers expect the integration of the ASAM ODS standard into test automation systems and into data evaluation tools. HORIBA is one of the lead companies in this standardization through our ASAM ODS implementation within our core STARS product.

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